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TREATISE
OF THE
EAR:

Containing an exact
DESCRIPTION
OF THE
SEVERAL PARTS thereof,
And their
RESPECTIVE USES;
With the
DISEASES it is liable to; and their CURE.

By M. DUVERNEY, Member of the Royal
Academy of Sciences at Paris, and Physician to
the late King of France.

Englified and Improved
JOHN MARSHALL, SURGEON.

Adorned with Sixteen neat Copper-Plates; representing
several Parts of the EAR, much larger than the Life.

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Mr. FREKE	{	Surgeons to St. <i>Bartholomew's</i> Hospital.
Mr. PHILLIPS		
Mr. BIGG		

GENTLEMEN,



WHATEVER tends to
the Benefit of Mankind
in general, has no need
of an Apology to intro-
duce it to the World;
and the more extensive the Benefit is,
the more valuable the Work must
be. Now as there is no Art or
Science but what in some manner
conduces to this End, so that parti-
cularly

cularly which frees us from Pain and Sickness, must certainly be of the most universal Advantage, and consequently merit the greatest Encouragement. Anatomy and Surgery are of this kind; the one may be said to be the Theory, the other the Practice, which like two neighbour Stars mutually reflect Light upon each other. The Knowledge therefore of our own Bodies, and an inquisitive Search into the Organs of our Senses, is not (as some idly imagine) a Matter meerly of Curiosity and Speculation. 'Tis this Knowledge, Gentlemen, which has so particularly distinguish'd you, and plac'd you in the Rank of the most Eminent in the Profession. I might here, like most Dedicators, though with infinitely more Truth and Justice, enlarge abundantly upon your great Abilities, and other shining Virtues which serve to dignify y^r Characters; but that there is no of a Pen to testify what is so proclaim'd by the Tongues of 7

The DEDICATION.

bands of poor Wretches, who owe their Lives as well as their Ease to that Skilfulness, Care and Humanity, the happy Influence of which they daily experience, and which I my self am frequently an Eye-Witness of. 'Tis upon this account, Gentlemen, and not upon any Presumption of my own Merit, that I am embolden'd to prefix your Names to this Translation; not only as a means of recommending it to the World, but as an acknowledgment of that Respect and Duty, which I shall always retain a grateful Sense of, and particularly of the many Favours and Obligations which are continually conferr'd upon me, by my worthy Master Mr. *Phillips*.

Nothing need be said in praise of the Author, this Treatise has gain'd him sufficient Applause from the most accurate Anatomists: But for this Translation (which I have endeavour'd to render as literal as possible) I submit it entirely
ly

The DEDICATION.

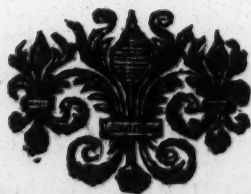
ly to your candid Judgments, hoping you'll excuse those Errors that may have escap'd me : And beg leave to subscribe my self,

Gentlemen,

Your Oblig'd

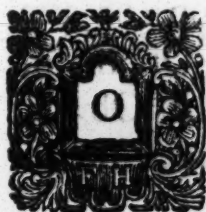
Humble Servant,

JOHN MARSHALL.





T H E

A U T H O R ' s *Advertisement.*

F all the Organs assign'd to the Use of Animals, we have the least Knowledge of those of the Senses; but there is none more obscure than that of Hearing: the Minuteness and Delicacy of the Parts which compose it, being inclos'd by other Parts, (which by reason of their Hardness, are scarcely penetrable) render the Enquiries into them more difficult, and their Structure something so intricate, that there is as much Trouble in explaining, as there was in overing them. It is easy to judge

judge how little known they were to the Ancients, by what they have wrote upon this Head: And amongst the Moderns, Mr. *Per-rault*, who in his *Physical Essays* has treated it with more Exactness and Perspicuity than any one yet, nevertheless has omitted many things on this Subject, applying himself to those particular Parts which serve for the better Explanation of the Nature of Sound, by the Organs of that Sense of which it is the Object. And this is what has induced me to write upon this Matter.

Altho' I don't pretend that this Work is entirely perfect, yet I am in hopes there may something more be found in it, at least, than hath been describ'd before; for I have endeavour'd (by all the necessary Precautions I cou'd take, to avoid the Obscurity which is to be met wit' in most Authors, that I have re upon this Subject,) not only to give an exact and compleat Description of all the Parts belonging to

Ear, but also to make that Description as plain and intelligible, as much as possible: To attain which, I have spar'd no Pains, but have search'd with all the Care and Patience imaginable, into the most minute Parts, examining their Substance, and their Figure, with a continual Apprehension of forgetting some Things, or mistaking one for the other.

For to make this Treatise more intelligible, I have been very careful and exact in the Figures, which are particularly necessary to render these sort of Descriptions neat: And because it is not enough that these Figures should be true and faithfully delineated, if they were not besides order'd and dispos'd in such a manner, that they may leave no room for Ambiguity; I have represented the Parts of the right Ear as they are in their natural Situation, preserve the first Ideas that they present upon the Mind, that they may not be confus'd nor destroy'd

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The AUTHOR'S

by one another. And because it often happens, that in seeing the same Parts in various Views, we mistake them for different Parts; I have left certain remarkable Parts, which are easily known again, such as the *Processus Zygomaticus*, *Mammillaris*, and *Styloides*, and the bony Passage of the Ear, to serve as an Index to the Reader, and which will be his surest Guide in his Enquiry into the Part which he examines. In short, that I might not omit any thing which I thought belong'd to the Subject which I treated of, I have added the Description of the Ear of a *Fœtus*, to that of the Ear of an *Adult*, wherein I have taken notice of all the Difference I ever met with between the one and the other.

As for the use of some Parts of this Organ, I must confess that every thing that I have said of it does not entirely satisfy me more than what others have upon this Subject; I don't

assert the Truth of those particular Things which were discover'd before me: As for those I have found out my self, they are things which I maintain to be true, which I have many times experienc'd upon a great Number of Subjects, and which I promise to demonstrate plainly to all those who shall have the Curiosity to inform themselves.

As I have resolv'd to give a Description of all the Organs of Sense, and since it is absolutely necessary to determine what is the Origin of their Nerves ; I have been obliged to make a new Plate of the Basis of the Brain, not being able to make use of any of the Figures that have hitherto appear'd, not even those of Mr. *Willis*. I have said nothing of the Senses, nor of Sensation in general, because I thought it necessary to know first the Structure of their Organs. I shall defer speaking of them, till I have finish'd a particular Description of all the Senses, and
in

in the Interim I shall give you their anatomical Use.

I finish this Volume with a little Treatise of the Distempers of the Ear and their Cure, which must be look upon as an Essay, I shall endeavour to perfect it by the different Observation, which I may have an opportunity of making.

ERRATA.

Pag. 22. Line 6. for Plate IX. Fig. 11. read Plate IX. Fig. 1. Pag. id. Line 15. for *Fenestræ* read *Fenestra*. Pag. 26. Line 6. after *side*, read *next to the Aqueduct*. Pag. 27. Lin. 12. for *Incus* read *Stapes*. Pag. 32. Lin. 10. for *dedcrib'd* read *describ'd*. Pag. 41. Lin. 12. for *there* read *these*. Pag. 54. Lin. 5. after *no* read *other*. Pag. 57. Lin. the last, for *upper* read *under*. Pag. 61. Lin. 6. after *fix'd* add *in Adults*. Pag. 62. Lin. 4. *Inferior* read *Superior*. Pag. 106. Lin. 2. for *read Oil*. Pag. 109. Lin. 15. after *Ears* read *also the Blood which comes out of 'em from the Head*. Pag. idem. Lin. 27. after *Blood* which are at the Basis of the Cranium. P for *I do find*, read *I don't find*. Pag. 118. after *consists in* read *Extracting*. Pag. 139. after *Particles* read *mov'd*.



OF THE
 ORGAN
 OF
 HEARING.

PART I.

*Containing the Structure of the
 Organ of Hearing.*



THE Ear itself without be- *The Exter-*
 ing dissected is divided in- *nal Part of the*
 to two Parts, that which *Organ of Hear-*
 appears externally from the *ing, called on-*
 Head, and is properly cal- *ly the Ear.*
 led the Ear; and that which
 < into the Head, and is call'd the
 of the Ear, or the Auditory Passage.

B

The

Is compos'd

The Ear is form'd of a pretty thick Cartilage, which is cover'd with a tender Skin, stor'd, especially in young Subjects, with a little Fat; under which is found another Nervous Covering, which strictly adheres to all the Cartilage.

Of a Cartilage,

This Cartilage commonly consists of many Foldings, which are continued and terminate in a Cavity call'd the *Concha*, from its Resemblance to the Entrance of a Snail-shell. The Winding or Folds of this Cartilage are more distinct in Adults, and their Figure is often varied.

Of Skin, of Fat, of a nervous Membrane,

Besides the Skin, the Cartilage, the Nervous Membrane, and the Fat, the Ear is furnished with some Muscles, and adorn'd with Arteries, Veins, and Nerves.

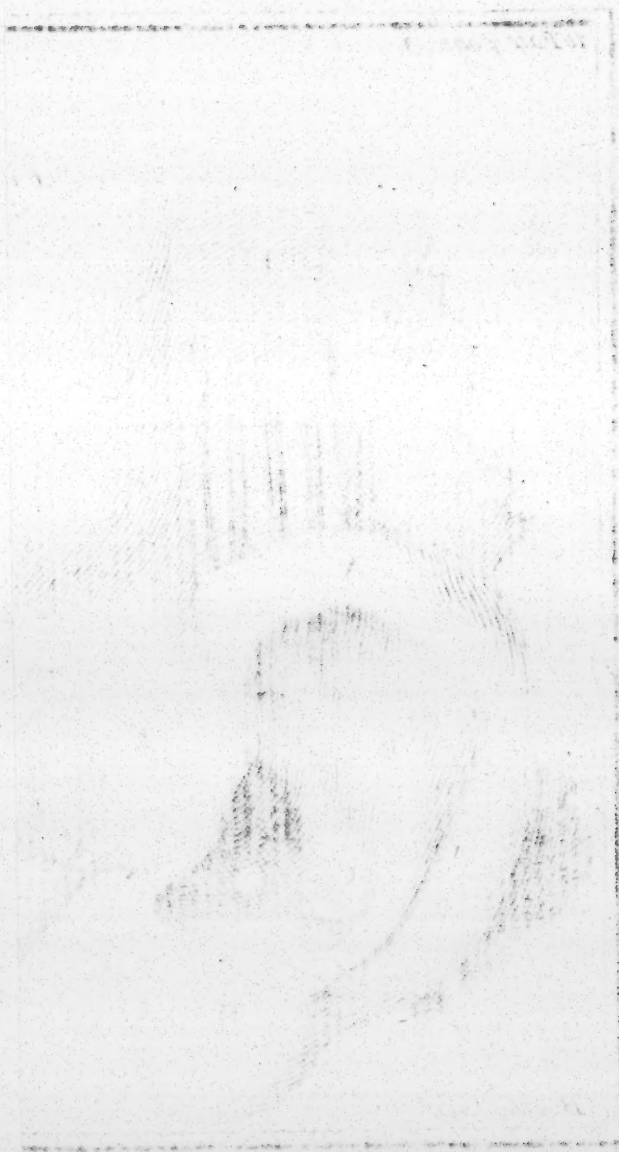
Of two Muscles.

It has two Muscles, the first consists of fleshy Fibres, which are fix'd to that part of the Skull which the *Musculus Temporalis* covers; they descend in a straight Line, and are inserted into the superior Part of the second Fold of the Ear: The second is also composed of five or six fleshy Fibres, which take their Origin from the superior and anterior Part of the *Processus Mammillaris*, they descend obliquely about the Length of an Inch and are inserted into the Middle of the *Concha*. See Plate I. Fig. I. and II.

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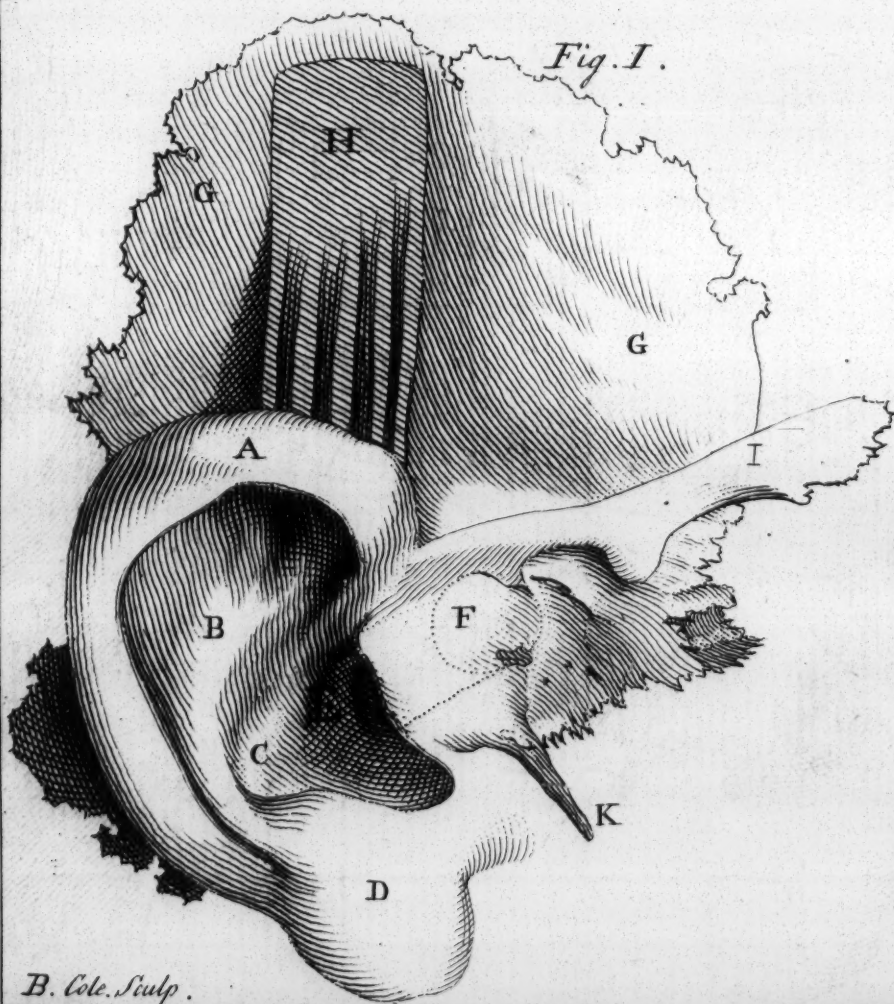
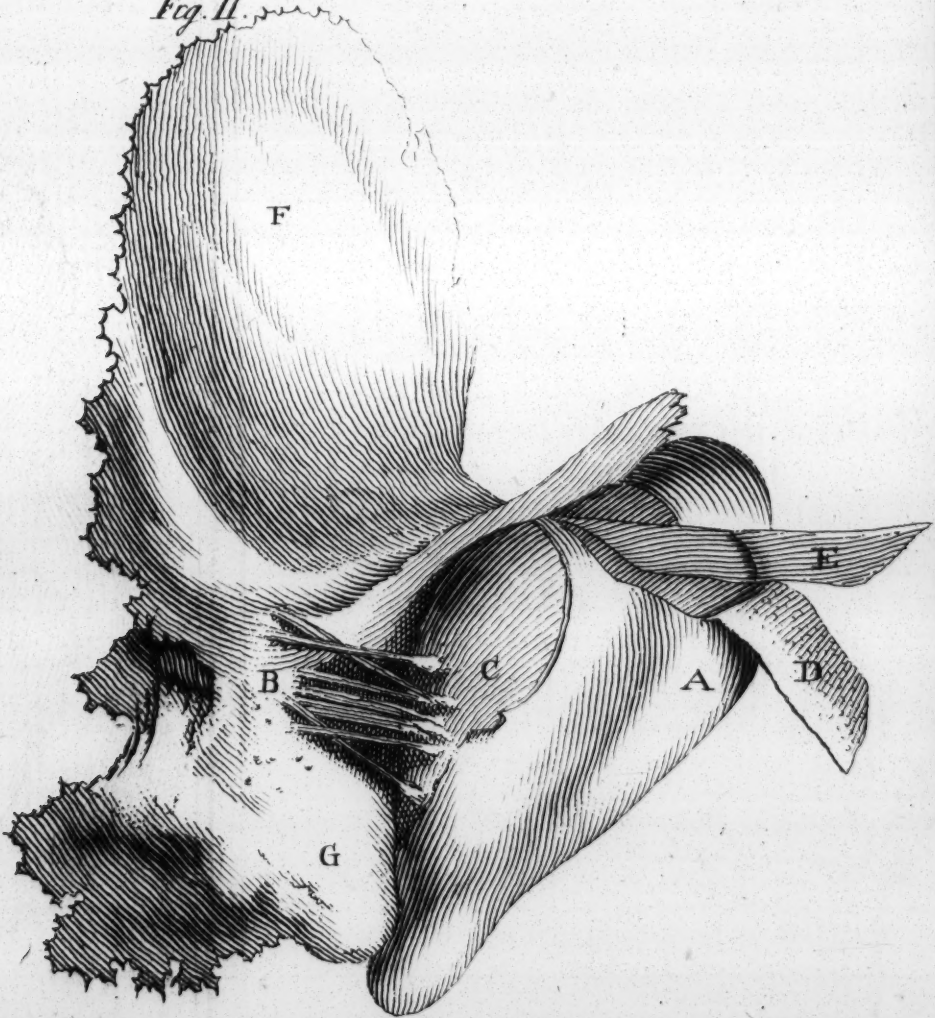


Fig. II.



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Explanation of Plate I.

Fig. I. represents the Ear in its natural Situation. A B C D, the Ear. A B C, its three Folds. D, the End of the Ear. E, the Concha, near E the Orifice of the Auditory Passage is seen. F, the Scituation of the Tympanum. The two dotted Lines shew the Length of the Passage. G G, the scaly Part of the Temporal Bone shewn bare. H, the first Muscle, which is here represented as lying upon the scaly Part of the Os Temporalis, because it is divested of the Temporal Muscle, upon which the Muscle belonging to the Ear is naturally scituated. I, the Processus Zygomaticus. K, the Processus Styloides.

Fig. II. represents the Ear revers'd, to shew its second Muscle and its Integuments. A, the Ear revers'd. B, the second Muscle of the Ear, whose Fibres have been divested of their Membranes, to render their Origins and Insertions the more distinct. C, the Place where the second Muscle is inserted, stript of the Skin. D, the Skin of the Ear, stor'd in the lower Part with a little Fat. E, the Nervous Membrane. F, the Scaly Part. G, the Processus Mammillaris.

Of Arteries. The Arteries are Branches of the external Carotid, which after part of them being distributed to the *Larynx*, and to many Parts of the Face, are divided near the Articulation of the *Maxilla* into two other Branches; one of which passes over the fore-part of the Ear, and the other over the back-part. That Branch which passes behind the Ear, sends off many little Ramifications, and is dispers'd all over the back Part of the Ear: One of the most considerable of these Ramifications enters the Ear near the Auditory Passage, and is afterwards distributed into a great Number of small Branches, which are expanded over the Skin, which lines the Inside of the *Concha*.

That Branch which passes over the fore-part of the Ear, is that which is perceiv'd to beat at the Temples, and which is commonly open'd for great Pains in the Head. In passing it is divided into many lesser Branches, which sprinkle the Cartilaginous Passage; and continuing its Course, it is again ramified, and sends forth in this place Branches, which are spread over the fore-part and back-part of the Ear.

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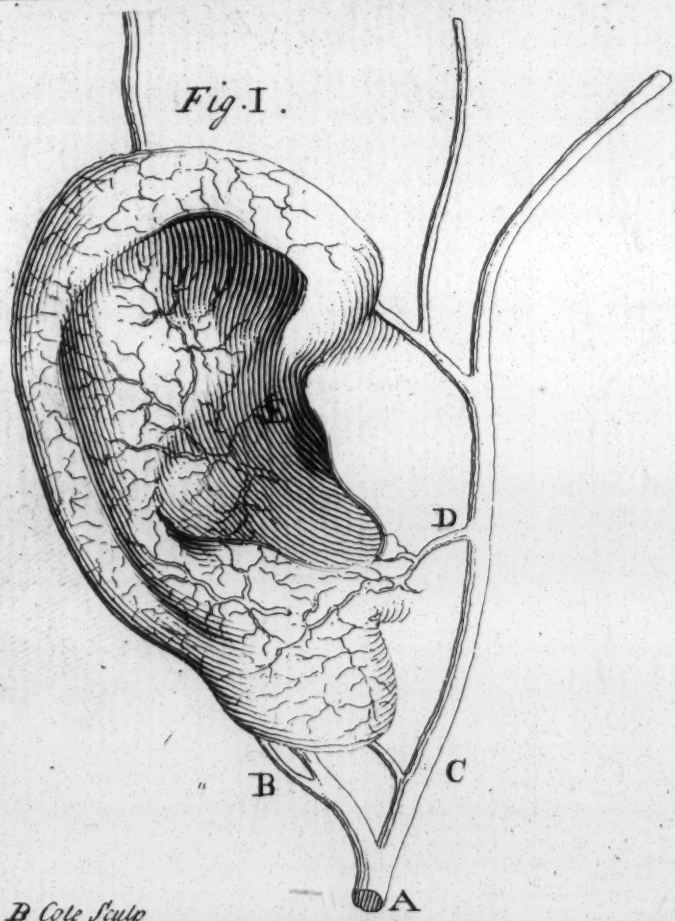
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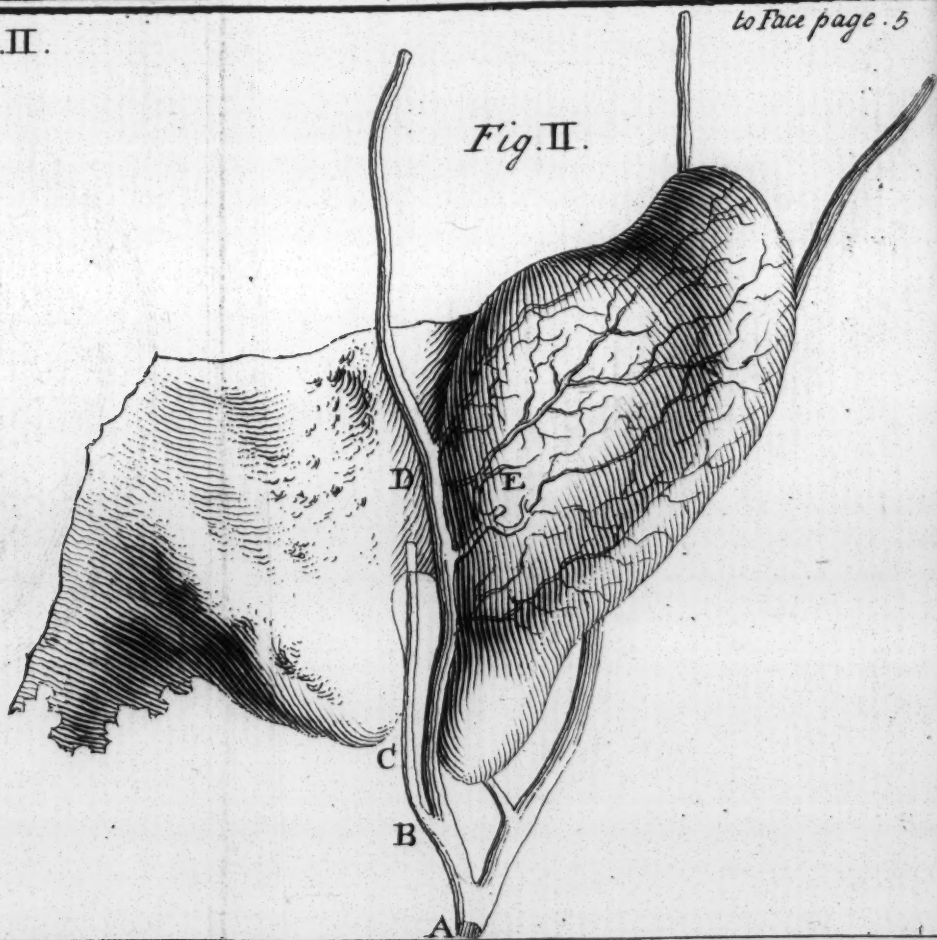


Fig. I.



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Fig. II.



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The Veins are Ramifications of the External Jugular, which follow the Distribution of the Arteries. See Plate II. Fig. I, II. *Of Veins.*

Explanation of Plate II.

Fig. I. represents the Arteries, which are distributed upon the fore-part of the Ear. A, the external Carotid, cut off above the Angle of the Jaw. B, the Branch which passes behind the Ear. C, the Branch which passes to the fore-part. D, the Ramification of this Branch, which is distributed to the Lobe of the Ear. E, a Branch of an Artery, which passes through the Cartilage from the back-part to the fore-part, and is distributed to the Inside of the Concha.

Fig. II. represents the back-part of the Ear, to shew the Arteries which are behind the Ear. A, the same Trunk of the Carotid. B D, the Branch which passes behind the Ear, and which as it passes furnishes it with many Ramifications. C, a Branch which is distributed to the Cavemulæ of the Processus Mammillaris. E, the Branch which passes through the Cartilage, to be distributed to the Inside of the Concha.

Of Nerves.

As for the Nerves, we shall treat of them when we come to describe all those which belong to the Organ of Hearing.

The Hole of the Ear is divided into two Parts.

That which is called the Hole of the Ear, is a Passage, of which the *Concha* is as the *Vestibulum* or Entry, and which leads to a Membrane, called the Drum.

1. The Cartilaginous Part.

This Passage is partly Cartilaginous, and partly Bony. The Cartilaginous Part is formed by the Contraction of the *Concha*; this Part is about four or five Lines in length; the Cartilage which forms it is continued in itself, but it is broke off and separated in many Places, as by so many Cuts which are not join'd together again, but by the Skin which covers the Inside of the Passage. This Cartilaginous Part covers but half the Auditory Passage, almost all the upper Part being only enclosed by the Skin, which lines its Inside. See Plate III. Fig. I. and II.

Which is broke off in many Places.

Explanation of Plate III.

Fig. I. represents the Cartilage of the Ear, and the cartilaginous Passage divested of all their Integuments. A, the Cartilage of the Ear, with its Folds. B, the cartilaginous Passage growing something flat.

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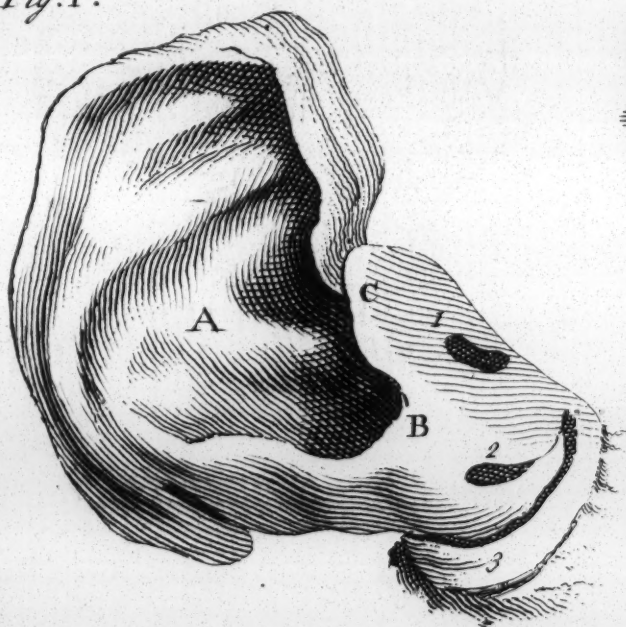
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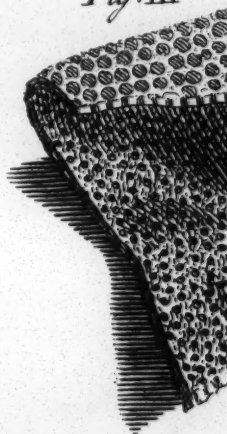
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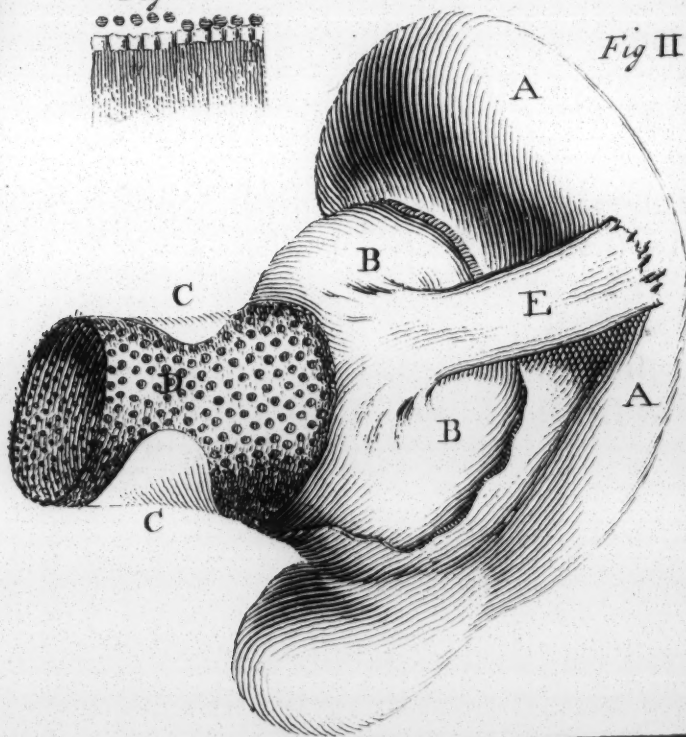
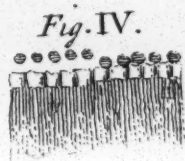
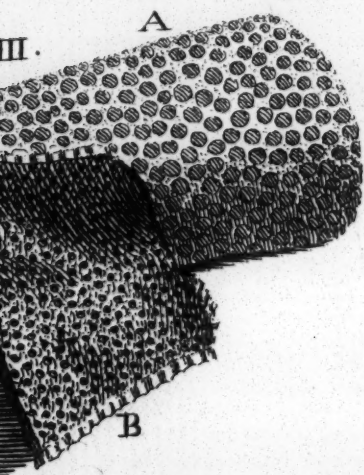
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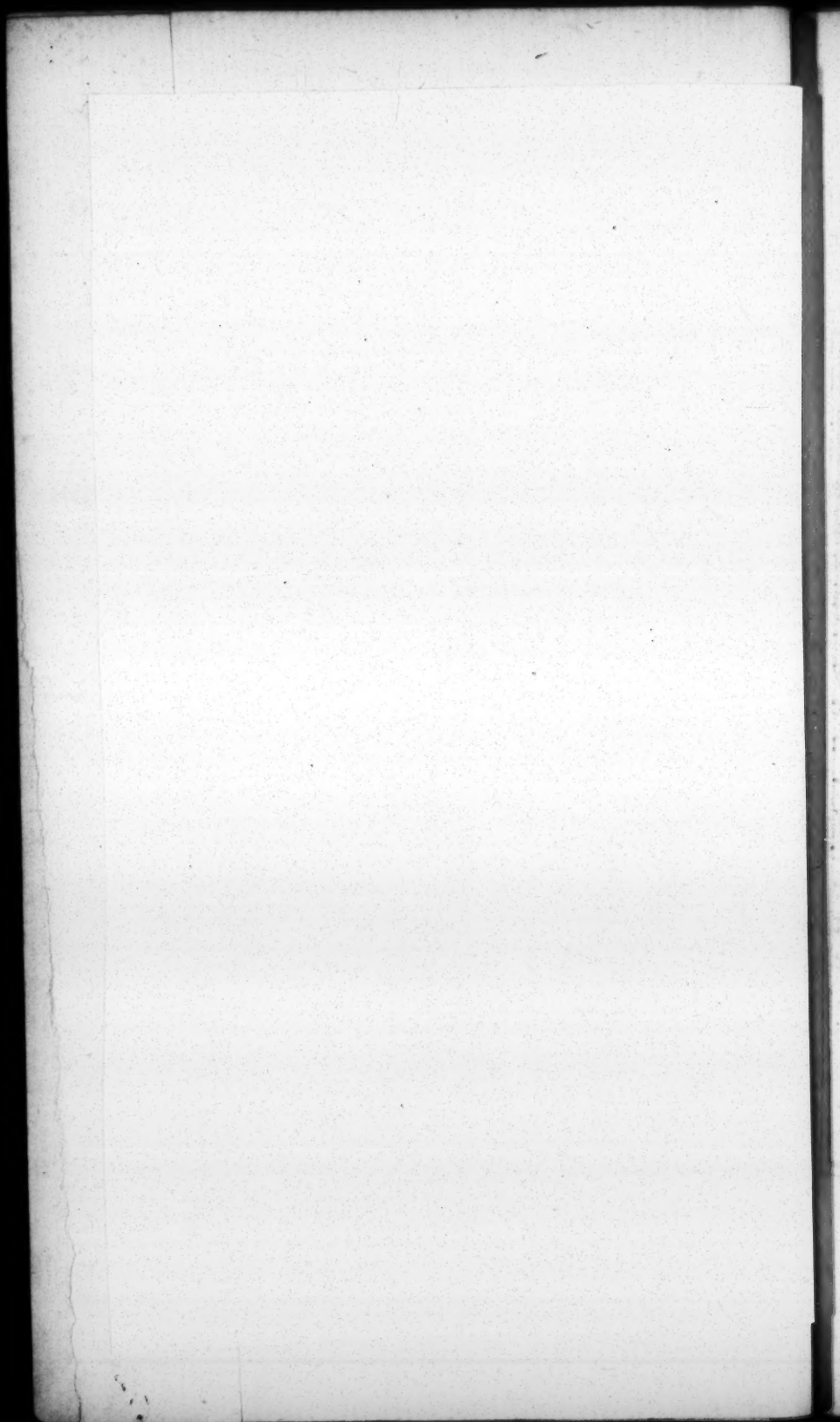


B Col. Sulp.

Fig. III.







C, the Part of the Cartilage which forms the Entrance of the Passage, and which makes a little Tongue at the forepart of the Concha. 1, 2, 3, The three Interruptions of the cartilaginous Passage.

Fig. II. represents the back Part of the Ear, and the upper Part of the cartilaginous Passage, with the Ligament, which lies the Concha to the temporal Bone. A, A, the back part of the Ear, B, B, the back part of the Concha, divested of the Skin. C, C, the Appendixes which terminate the Cartilage in the upper Part. D, the superior Part of the Passage, which is form'd of nothing but of a glandular Membrane. E, the Ligament of the Ear revers'd.

Fig. III. represents the glandular Membrane, which invests the cartilaginous Passage; it appears in this place three times larger than Nature, for the better distinguishing all the Parts. A, the exterior Part of the glandular Membrane. B, the Passage open'd, in which the small Hairs and the Orifices of the excretory Ducts of the Glands are visible.

Fig. IV. represents the Diameter of the Part of the Passage, to shew how the Glands are half buried in the Thickness of the Membrane: Some of them are drawn out, to shew more plainly how deep they are buried.

*And cover'd
with a Skin.*

*Adorn'd
with many
little Glands.*

*And is con-
nected to the
Os Tempo-
rum by a Li-
gament.*

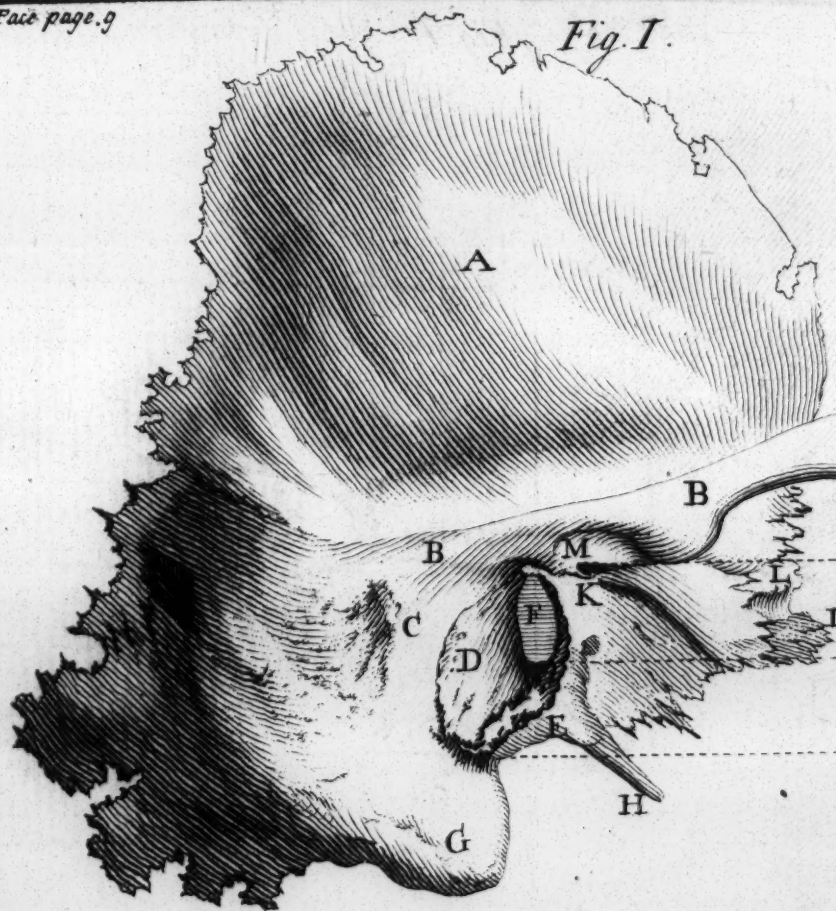
This Skin, which is a Continuation of that which is in the fore-part of the *Concha*, is strew'd with an infinite Number of small Glands of a yellowish Colour, and a little inclining to an oval Figure, which lie under this Skin, and are somewhat depress'd in its Thickness. Each Gland has a small Duct, which opens into the Cavity of the Passage among the little Hairs with which it is stor'd: And these are the small Ducts which emit that thick glutinous and yellow Matter, which is commonly found in the auditory Passage. This cartilaginous Passage ends by adhering to many Inequalities, which are at the entrance of the bony Canal; which is only a Continuation of that which is Cartilaginous. These Inequalities are pretty considerable on that side of the Entrance next the Face, to which the Cartilage strictly adheres. And as there are but few of these Inequalities at the opposite Side, next to the back part of the Head, the Cartilage is connected in this place to the Bone by a strong Ligament; which coming from the Extremities of the *Concha*, passes along the membranous Part of the cartilaginous Passage, and is inserted into a small Cavity in the *Os Temporale*,

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Fig. I.

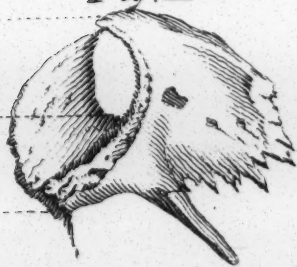


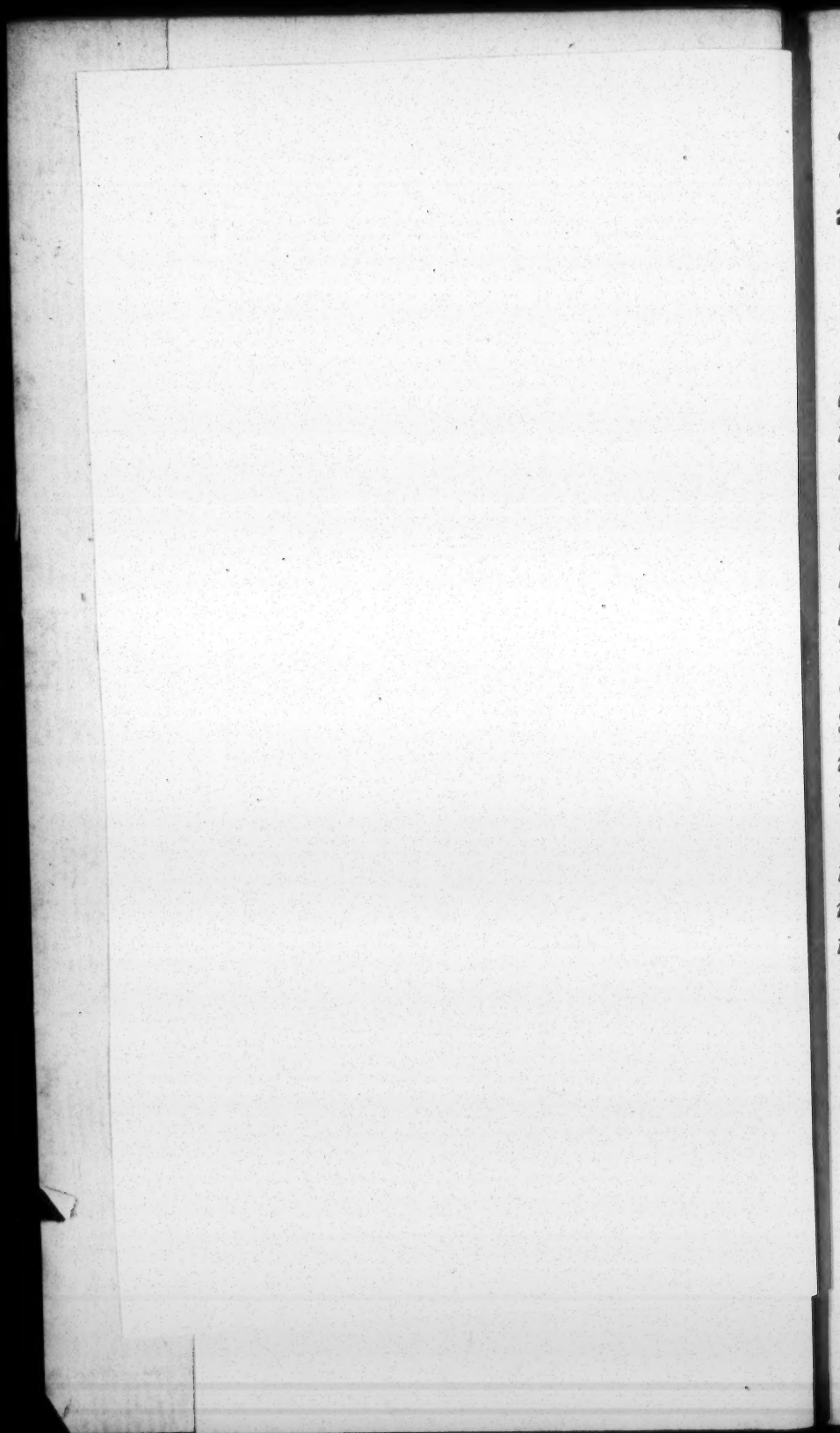
B. Cole. Sculp.

Plate. IV.



Fig. II.





of HEARING.

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Temporale, at the Entrance of this bony Canal. See Plate III, Fig. II, III, IV. and Plate IV. Fig. I.

Explanation of Plate IV.

Fig. I. represents the *Os Temporale* bare. A, the scaly Part of this Bone. BB, the *Processus Zygomaticus*. C, the little Cavity, into which the Ligament of the Ear is inserted. D, the Entrance of the bony Passage of the Ear. E, the Inequalities which are on that Side of this Entrance next the Face. F, the *Membrana Tympani*, in its Situation. G, the *Processus Mammillaris*. H, the *Processus Styloides*. I, the Tube, which incloses the internal Carotid. K, a small Sinus, which is between the bony Passage and the scaly Part of the *Os Temporale*, through which the external Muscle of the *Malleus* penetrates into the *Tympanum*. L, the Extremity of the bony Passage, which forms part of the Passage which goes from the Ear to the Palate. M, the Cavity, into which the *Condylode Process* of the lower Jaw is inserted.

Fig. II. represents the bony Passage, taken off from the temporal Bone.

2dly. The
bony Part.

This bony Part of the Auditory Passage, appears as if it was join'd to the *Oss temporale*. This Passage is, as it was said before, the Continuation, or rather the Foundation of the cartilaginous Passage: Its Bore is a little Oval at the Beginning, but the more it advances towards the Extremity, it grows flat.

The cartilaginous and bony Parts form the auditory Passage.

That which is called the Auditory Passage, is form'd of a cartilaginous and bony Canal, placed one at the End of the other; this Canal runs obliquely and grows curv'd. For its Course, which at first ascends and proceeds from the hind part to the fore-part, as far as its Middle, turns aside afterwards, and descends again, always proceeding forwards as far as the *Membrana Tympani*. See Plate IV. Fig. I, II.

The external Part of the Organ of Hearing, is separated from the internal, by the *Membrana Tympani*.

At the End of this Passage we find the *Membrana Tympani*, which separates the above describ'd external Ear from the Internal, and exactly closes up the Extremity of the Passage, as before taken notice of. This Partition is compos'd of a thin, dry, firm, transparent Membrane, almost round, and connected into a hollow Groove in the Circumference, at the end of the bony Passage. This Groove lies nearer the Inside of the Head at its Bottom

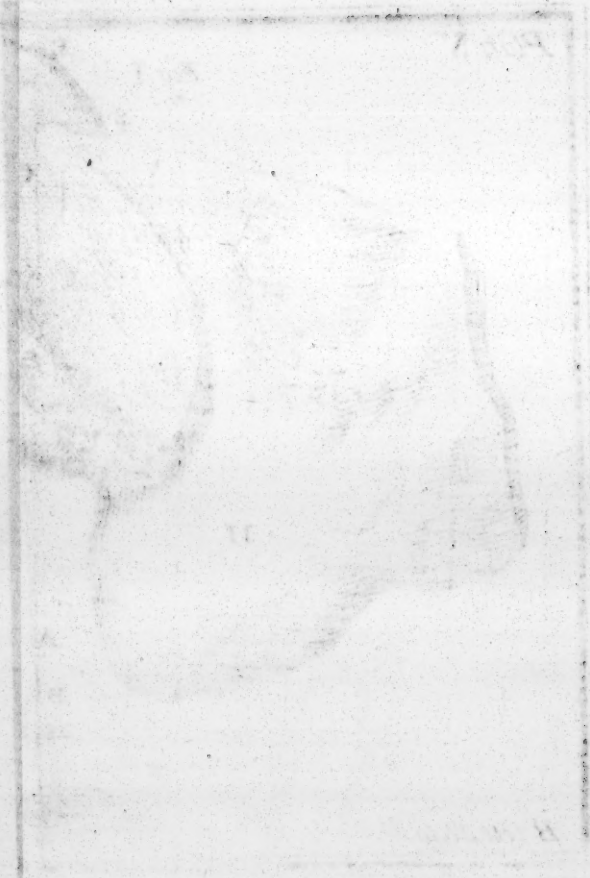
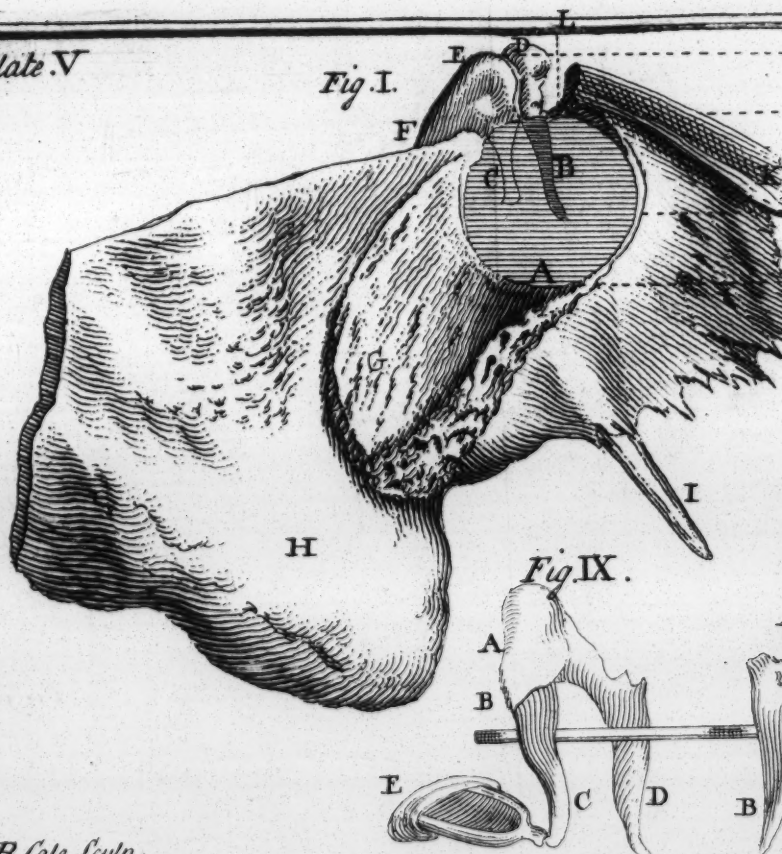
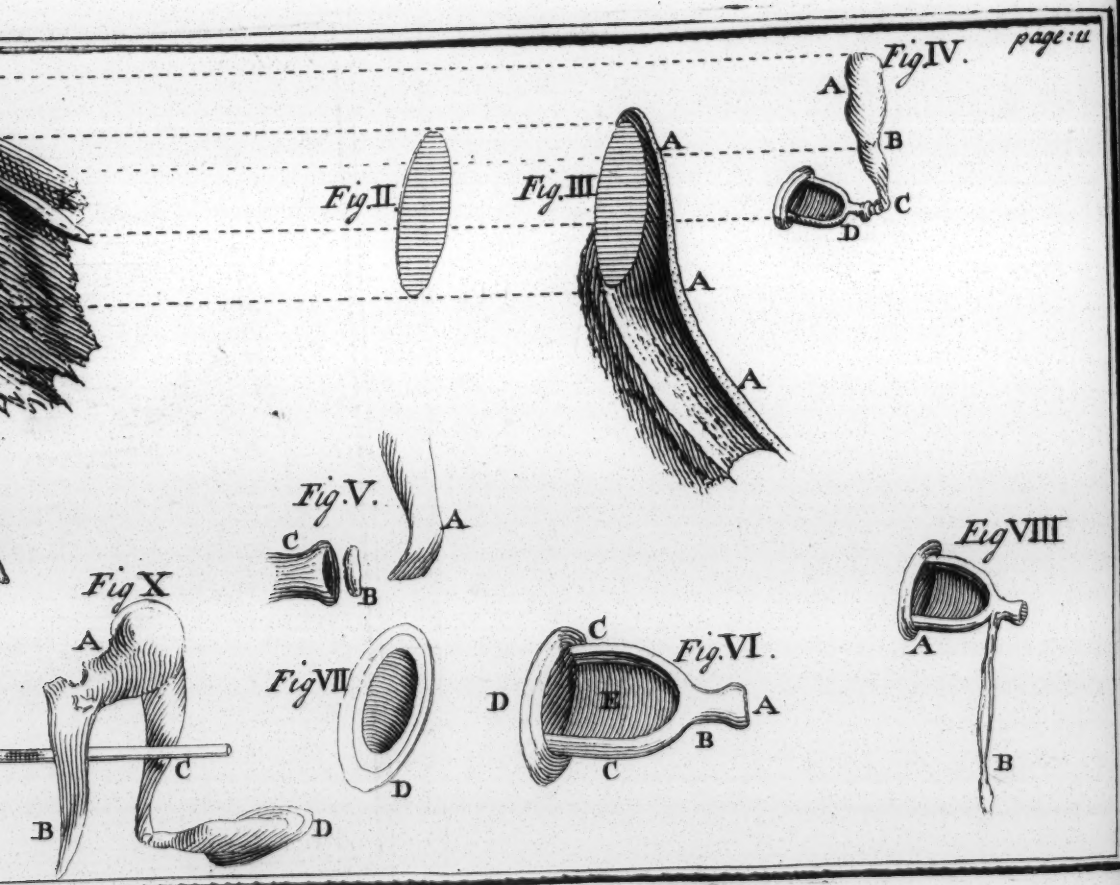


Plate V



B. Cole. Sculp.



tom than at its Top ; it does not make a compleat Circle, but ends at the upper parts of its Circumference. Although this Membrane be extended, yet it does not make a plain Superficies ; but it is indented inwards, by being fixed to the Handle of the Malleus. See Plate V. Fig. I, II, III. and Plate VII. Fig. I, II.

Explanation of Plate V.

Fig. I. represents the temporal Bone twice as large as Nature, in which all the scaly Part is cut off, and but as much of the bony Passage taken away, as was necessary to shew the Membrana Tympani bare. A, the Membrana Tympani in its Situation, and seen in the Front. B, the Handle of the Malleus, which is join'd to the back part of this Membrane. C, the long Branch of the Incus, which appears cross this Membrane, though it is a little way remov'd from it. D, the Head of the Malleus. E, the massy Part of the Incus, with its short Branch. F, which in this Section appears plainly. G, the bony Passage, half of which is cut off. H, the Processus Mammillaris. I, the Styloides. K, the external Muscle of the Malleus in its Situation. L, a punctur'd Line, which shews

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Of the ORGAN

the thin Process of the Malleus, into which this Muscle is inserted.

Fig. II. represents the Membrana Tympani seen sideways, to shew the better how it inclines.

Fig. III. represents the Membrana Tympani in the same View, and fix'd in the Extremity of the bony Passage; it also shews in what manner the Side of this Passage next the Face recedes, at the lower part from the Membrana Tympani, and how it approaches insensibly nearer to it as it ascends. AAA, the Side of the bony Passage next the Face.

Fig. IV. represents the Incus, and the Stapes in their Scituation sideways. A, the massy Part of the Incus. B, the short Branch of the Incus, which in this Scituation appears exactly in the Front. C, its long Branch. D, the Head of the Stapes, which is joined with the long Branch of the Incus, by the Intervention of a fourth little Bone.

Fig. V. represents the Beak of the long Branch of the Incus, the fourth little Bone and the Head of the Stapes with its Cavity; all of them being four times larger than Nature. A, the Beak of the long Branch of the Incus. B, the fourth little Bone. C, the Head of the Stapes with its Cavity.

Fig.

Fig. VI. represents the Stapes five times larger than Nature. A, the Head of the Stapes. B, its Collum or Neck. C C, its Branches, which are hollow like a Gutter. D, its Basis. E, the Membrane of the Stapes.

Fig. VII. represents the Basis of the Stapes seen in the same Sense, to shew that it is hollow like a Gutter. D, the Basis of the Stapes.

Fig. VIII. represents the Stapes with its Muscle in its natural Scituation. A, the Stapes. B, its Muscle, the whole being represented twice as large as Nature.

Fig. IX. represents the Officulæ seen in the Scituation they would be in, if the Eye was placed in that Passage which penetrates into the Proceffus Mammillaris. A, the massy Part of the Incus. B, its short Branch seen in the Front. C, its long Branch. D, the back part of the Handle of the Malleus. E, the upper part of the Stapes.

Fig. X. represents the Officulæ in their Scituation, view'd from the opposite Side, the Eye being placed in the Passage which passes from the Ear to the Palate. A, the Head of the Malleus, which covers the massy Part of the Incus, and its short Branch. B, the Handle of the Malleus. C, the long

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long Branch of the Incus. D, the Stapes seen sideways: The Stick which crosses the Officulæ is placed here, to distinguish which are placed before and which behind, in these different Views.

Explanation of Plate VII.

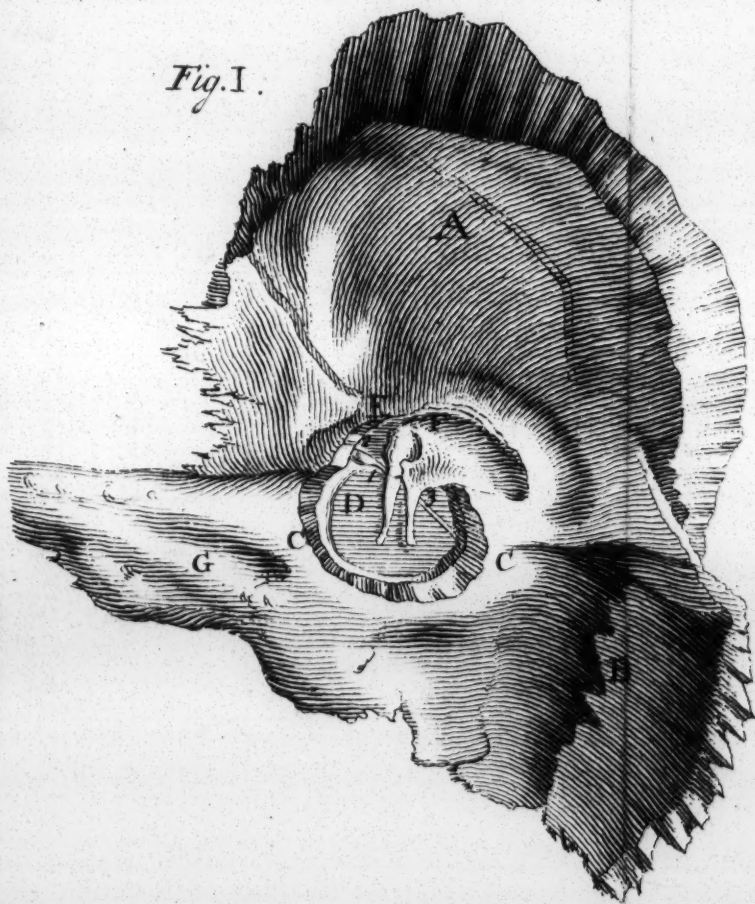
Fig I. represents the back part of the temporal Bone, with as much of it cut off as was necessary to show the Membrana Tympani, upon which the back part of the Malleus and Incus is shewn, with the small Branch of a Nerve, called the Chorda Tympani, and the Tendon of the external Muscle of the Malleus, besides the Cavity, upon which the Head of the Malleus and the massy Part of the Incus rests, all in their natural Scituation. A, the back part of the scaly part of the temporal Bone. B, The Proceffus Mammillaris, in the same View. CC, the Os Petrosum cut off. D, the Membrana Tympani. E, the Malleus. F, the Incus with its short Branch, resting upon the Entrance of the Passage, which penetrates into the Cavernulæ of the Proceffus Mammillaris. G, the Foramen of the auditory Nerve. 1. The Tendon of the external Muscle of the Malleus. 2, 3. The Chorda Tympani.

Fig.

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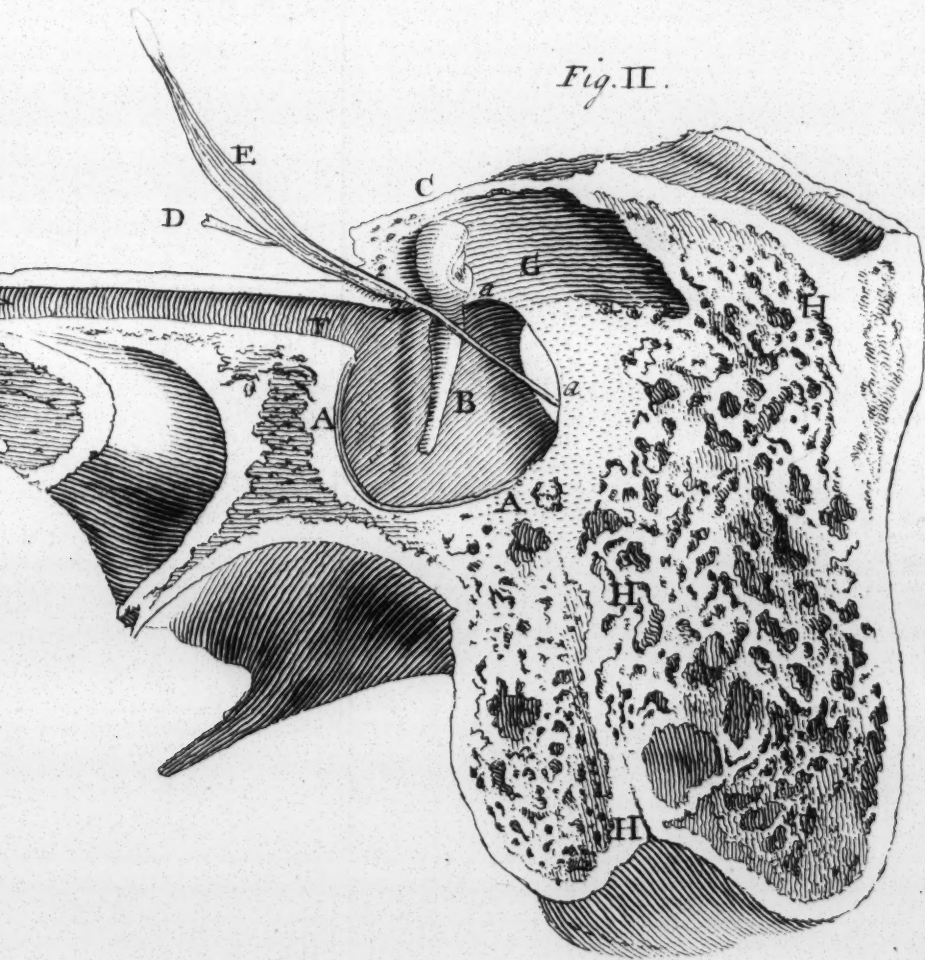
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Fig. I.



B. Cole. Sculp.

Fig. II.



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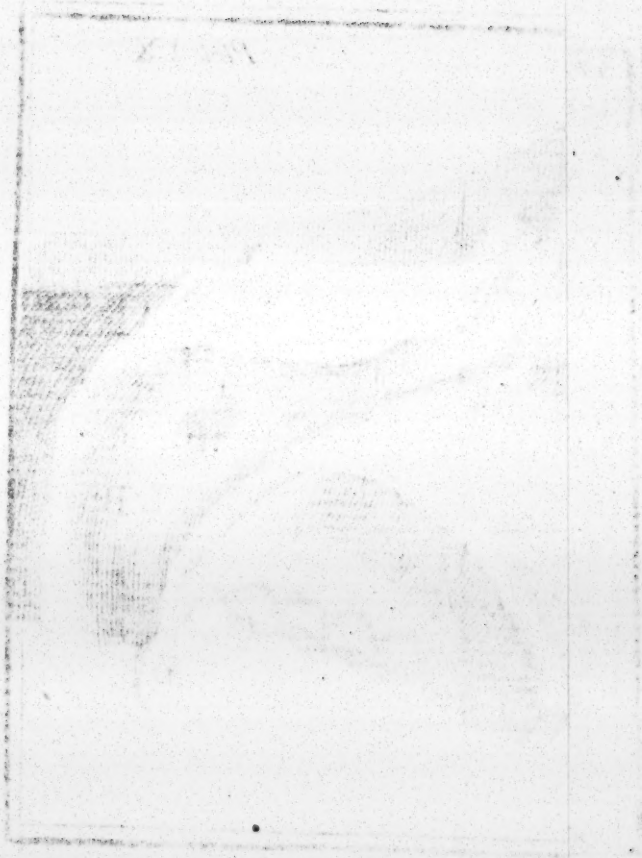
Fig. II. likewise represents the back part of the Os Temporale twice as large as Nature, all the scaly Part of which is taken away, and is saw'd from the Top to the Bottom, according to the Plan of the Groove, in such a manner, that it is divided through the Middle of the Processus Mammillaris: By this is shewn the Groove which receives the Membrana Tympani into it, and the Place where this Groove is wanting; it also shews how the Side of the bony Passage, next the Face grows flat near its Bottom, and covers a Part of the Membrana Tympani; and lastly, it discovers all the Cavernulæ of the Processus Mammillaris. AA, the Groove. aa, the Place where it is wanting. B, the Side of the bony Passage next the Face, which grows flat in this Place. C, the Malleus. D, the Chorda Tympani which is drawn inwards, to show how it passes over the external Muscle. 2, 3. The small Sinus which is excavated out of the Bone above the Groove, and which serves as a Pulley to the Muscle. E, the external Muscle, which is also drawn inwards. FF, the bony Part of the Passage, which goes to the Palate. G, the Passage which leads into the Processus Mammillaris. H, H, the Cavernulæ of the same Process.

Behind

The first Cavity in the internal Ear, called the Tympanum, or Drum.

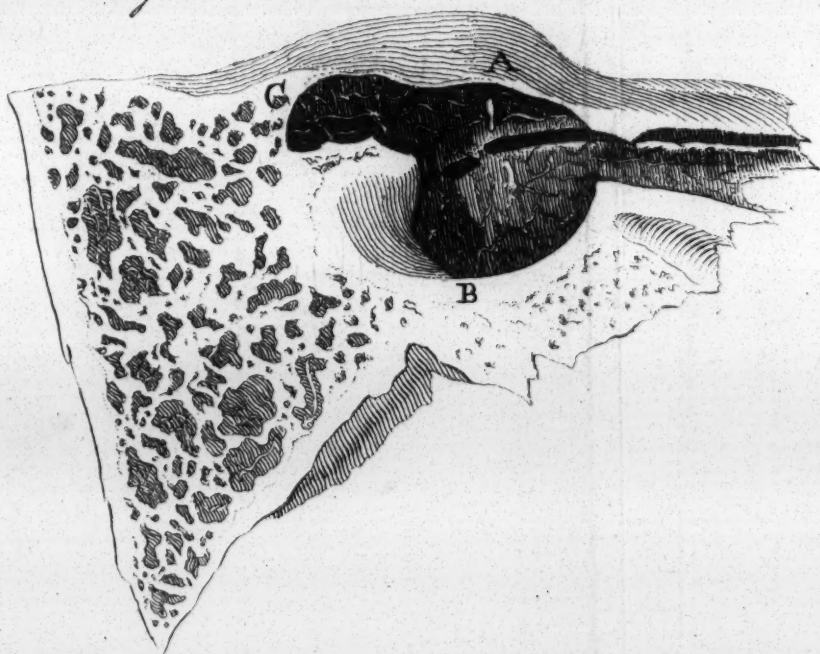
Behind this Membrane is a Cavity called the *Tympanum*, from a sort of Resemblance it bears to the Box of a Drum, being on every Side surrounded with Bone, enclos'd before by the above-mention'd Membrane, and behind by the Surface of the *Os Petrosum*. This *Tympanum* is two or three Lines deep, and six broad; there are two Passages in its Sides, one of which is situated in the fore-part, and is called the Aqueduct, and opens into the Palate. The other is situated on the opposite Part, and in the Top of the Cavity opens into the *Cavernulae* or Sinuositys of the *Processus Mammillaris*: At the Top of this *Tympanum* there is a small Cavity, in which the Heads of the *Ossicula*, (which we shall describe in the sequel) are placed. The Cavity of the *Tympanum* is rugged, unequal, and furnish'd with a Membrane, which is strew'd with a great Number of Vessels, some of which are Ramifications of the carotid Artery, which are distributed to the *Dura Mater*: The *Foramina* through which they pass are placed in the superior Part of the *Tympanum*, and very nigh the *Foramen*, through which this Artery belonging to the *Dura Mater* enters the *Cranium*.

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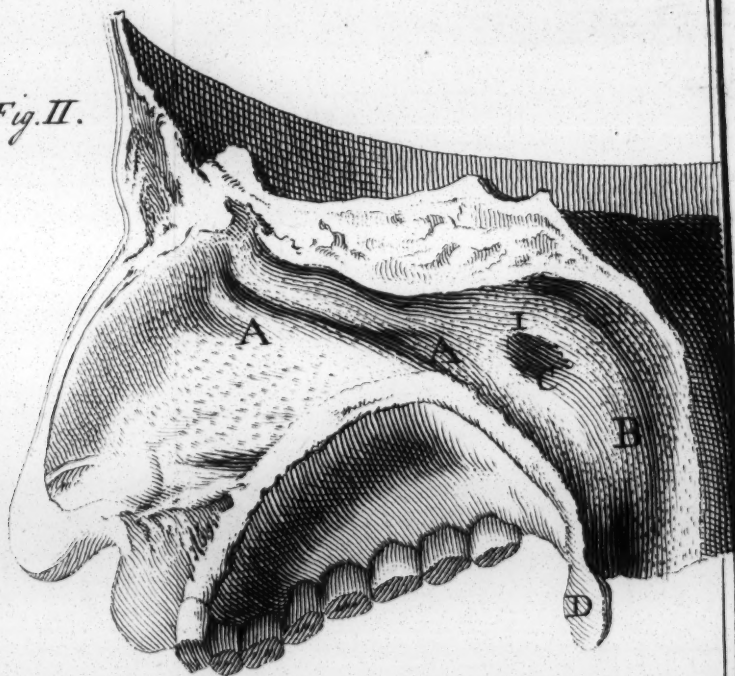
Fig. I.



B. Cole, Sculp.

Plate IX.

Fig. II.



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nium. The others are Ramifications of those that furnish the Membranes, which cover the *Cavernulæ* of the *Processus Mammillaris*. See Plate IX. Fig. I.

Explanation of Plate IX.

Fig. I. represents the temporal Bone twice as large as Nature, all the scaly Part being taken off, and being saw'd perpendicular down a little distance before the Groove, to shew the Depth of the Tympanum and the *Cavernulæ* of the *Processus Mammillaris*, to discover their Vessels, and those which are spread upon the Membrane, which lines the Tympanum. A, a considerable Artery, which is a Ramification from that of the Dura Mater. B, a Vein which is sent off at the Entrance of the internal Jugular, which is at the bottom of the Tympanum. C, the Vessels which are sent off from the *Cavernulæ* of the *Processus Mammillaris*, to be distributed to the Tympanum.

Fig. II. represents half a Head one third less than Nature, all the upper Part of the Cranium of which is taken off, and the rest cut perpendicular through the Middle of the Nose, to shew the Orifice of the Passage which goes from the Ear to the Palate. A A, the Cavity of the Nose, with its Laminæ.

Laminæ. B, *the Fundus of the Palate.*
 C, *the Orifice of the Passage which leads from the Ear to the Palate.* 1. *Its cartilaginous Side, which forms a Border in the shape of a Crescent.* D, *the Uvula cut through the middle.*

Has five remarkable Things in it.

There are five remarkable Things to be taken notice of in the whole *Tympanum*, viz. Two Passages, two *Fenestræ*, four small Bones, three Muscles, and a Branch of a Nerve.

1. *Two Passages, one of which passes into the Palate.*

The Passage which passes from the Ear into the Palate, is called *Aqueduct*, not only because it is like a Canal, but also because it can make room for the Filth and other extraneous Humours, which are often gathered in the Inside of the *Tympanum*, not being provided with any small Valve to hinder their Egress. This Passage is bony as it comes from the *Tympanum*, and its Inside is lin'd with the same Membrane which covers the *Tympanum*. It is situated in the fore-part of the bony Canal, which encloses the internal carotid Artery, and afterwards proceeding about three Lines in length, it terminates by many Unevennesses, which form Gaps, to which another Tube partly membranous and partly cartilaginous

is fix'd, which composes the rest of the Passage. The membranous Side of this Passage faces the Hole of the Ear, and the cartilaginous Part the back-part of the Head. This Tube runs obliquely backwards as far as the Root of the Nose, at the Extremity of the Palate, a little above the *Uvula*, and proceeding about the length of an Inch, it ends near the Middle of the interior Part of the internal Side of the Processes, which are called *Pterigoidei*. This Passage is much larger than that which is bony; it is cover'd on the Outside by one of the Muscles, which serve to dilate the *Pharynx*, and on the Inside by a glandulous Skin, which is a Continuation of that which lines the Inside of the Nose. The cartilaginous Part of this Passage grows thick towards its End, and forms a Border in the shape of a Crescent. The Insertion of the Aqueduct is so dispos'd, that the Air which is receiv'd into the Mouth through the Nostrils, is necessarily drawn into it. For the Horns of the Crescent, particularly the lower one, extend in such a manner into the Inside of the Nostrils, that it is impossible but that the Air must strike against these Horns as it passes along; and that a great Part of this Air being stop'd, and as it were

were intercepted in the Passage, must enter into the Aqueduct; otherwise all the Air would pass through the great Apertions of the Nostrils, directly into the Cavity of the Thorax. Mr. *Louyer* has observ'd a like Piece of Mechanism in the Insertion, or Opening of the axillary and carotid Arteries into the *Aorta*. For this Vessel which passes out of the left Ventricle of the Heart, growing curv'd as it descends, would carry almost all the Blood which is sent out of the Heart into its descending Trunk, if the axillary and carotid Arteries, which arise from the Middle of the Curve of the *Aorta*, were not dispos'd, in such a manner, that that Side of every Orifice which is the farthest from the Heart, being more elongated than the other, they stop a great part of the Blood as it passes before their Orifices. See Plate VIII. Fig. I, II. and Plate IX. Fig. II.

Explanation of Plate VIII.

Fig. I. represents the temporal Bone twice as large as Nature, the scaly Part being taken off, and part of the bony Passage taken away, and in general all the Parts of the Tympanum, which might hinder the View of the Surface of the *Os Petrosum*, which

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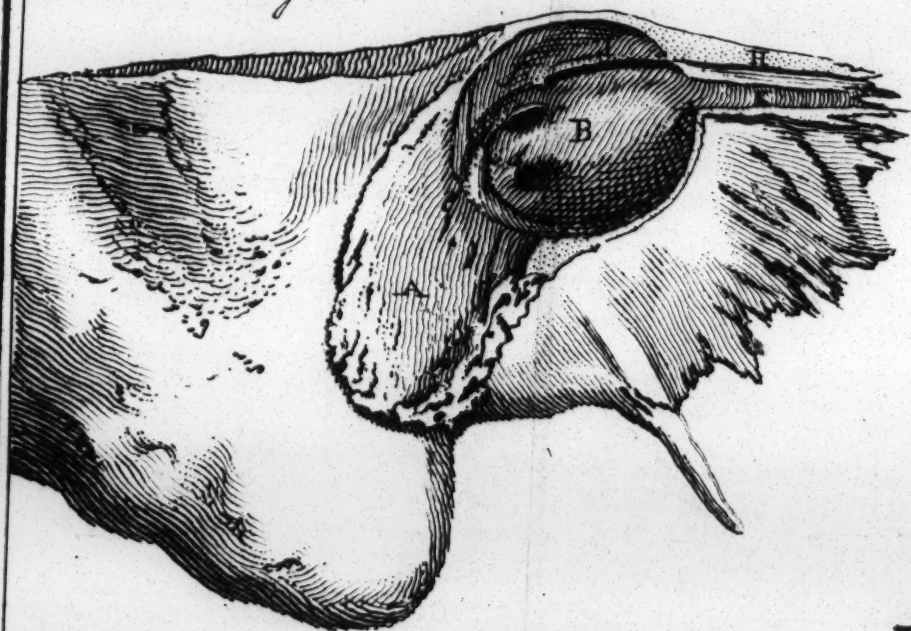
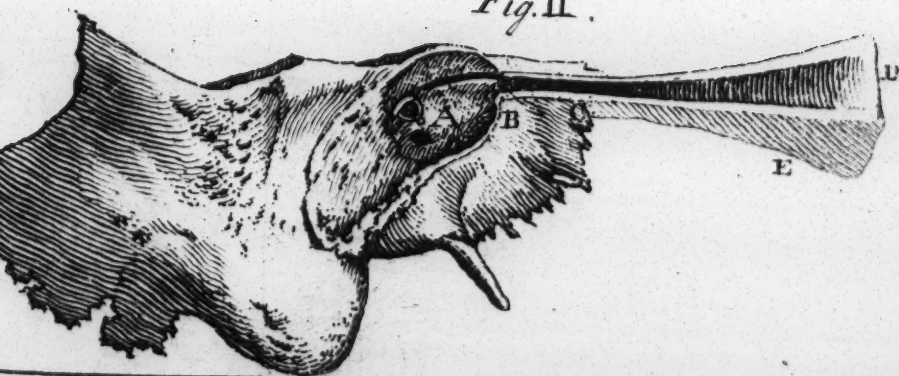


Plate.VIII.

Fig. II.



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which makes one of the Parietes of the Tympanum. A, Part of the bony Passage. B, the Protuberance which is in the Surface of the Os Petrosum, and which covers the Lamina Spiralis. C, the Fenestra Ovalis. D, the Fenestra Rotunda. E, the bony Canal which encloses the Muscle of the Stapes, from which the Tendon is shown extruded, to be inserted into the Head of the Stapes. F, the Canal which encloses the Portio Dura of the auditory Nerve. G, a punctur'd Line to shew the Circumference which the Membrana Tympani takes up, and how large the Tympanum is. H I, the Semi-Canal, which encloses the internal Muscle of the Malleus. H, that Part of this Semi-Canal, which is extruded from the Tympanum. I, the Part which is in the Tympanum. K, half of the bony Passage, which leads from the Ear to the Palate.

Fig. II. represents the temporal Bone, pretty nigh in the same View as the preceding Figure, but only as large as Nature, to shew the Stapes in its Situation, and the Canal which leads from the Ear to the Palate in its natural Direction. A, the Stapes in its Situation. B C, the bony Part of the Canal. D, its cartilaginous Part, which grows thicker and larger at its Extremity. E, its membranous Part turn'd back. The

The other The other Passage, which is scituated
into the Ca- on the Top of the *Tympanum* is broader,
vernulæ of the but much shorter than the Aqueduct, and
Processus penetrates, as before mentioned, into the
Mammillaris. *Cavernulæ* of the *Processus Mammiformis*.
 See Plate VII. Fig. II. Plate IX. Fig. II.

2dly, *Two* The two Apertures, or *Fenestræ* of the
Apertures, or Tympanum, are placed in the Surface of
Fenestræ. the *Os Petrosum*, which lies directly op-
 posite to the *Membrana Tympani*. The *Os*
Petrosum being about the thickness of a
 Line where they pierce, is the Reason
 why each of these *Fenestra* forms a sort of
 a small Passage, the Thickness of a Line.
 The first *Fenestræ* is called Oval from its
 Figure, and is scituated a little higher than
 the other. At the end of its Passage it
 has a small Border in the form of Foliage
 upon which the Basis of one of the small
 Bones, term'd *Stapes*, is placed. The
 other *Fenestra*, which is call'd *Rotunda* or
 Round, though it is like the other of an
 Oval Figure, has a Groove in the mid-
 dle of its Passage, for the Insertion of a
 dry, thin, and almost transparent Mem-
 brane, very like that of the *Tympanum*.
 See Plate VI. Fig. I. Plate VIII. Fig. I.
 II. and Plate IX. Fig. I.

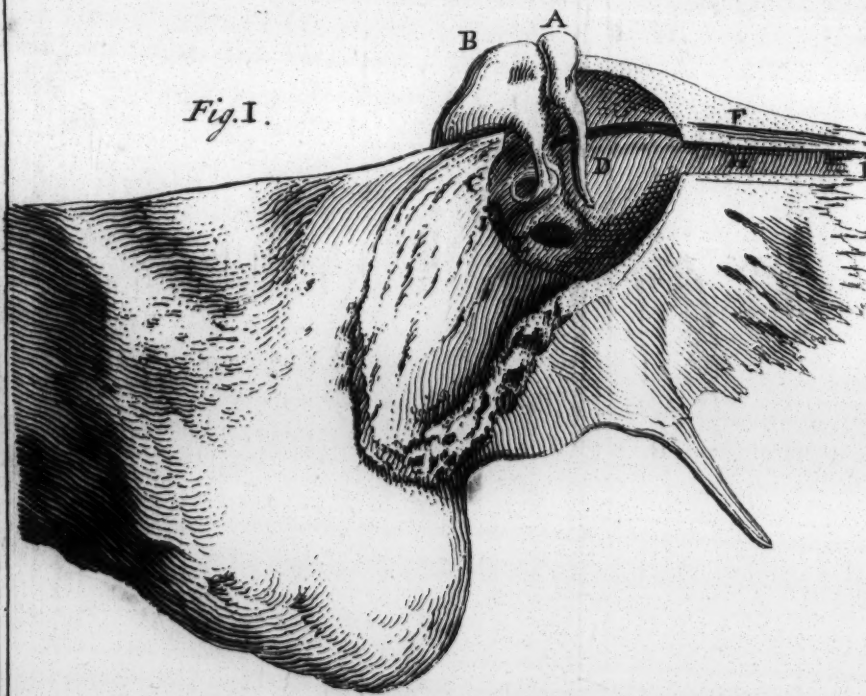
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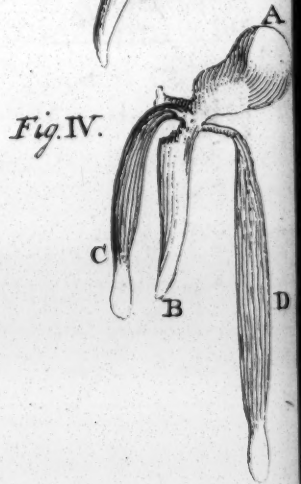
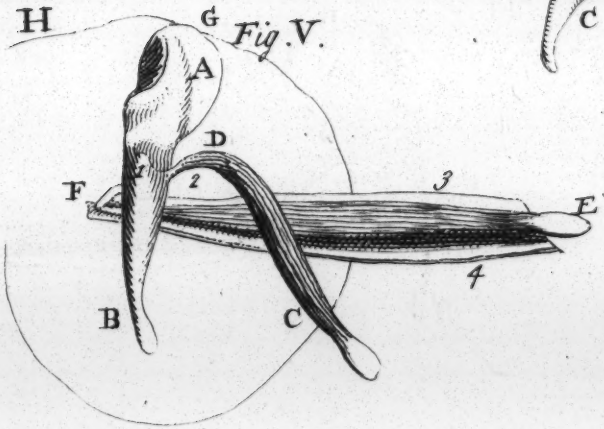
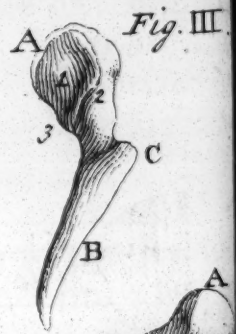
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Plate VI

Fig. I.



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Explanation of Plate VI.

Fig. I. represents the same Bone, cut in the same manner as Fig. I. of Plate V. The whole being also twice as large as Nature, only the Membrana Tympani is taken off, to shew the *Officulæ* in their Scituation, and the Inside of the Tympanum with its contain'd Parts. A, the Malleus. B, the Incus. C, the Stapes seen in the Front, its Head being cover'd by the Beak of the long Branch of the Incus; its Basis stopping up the Fenestra Ovalis. D, the Fundus of the Tympanum, which is the Surface of the Os Petrosum. E, The Fenestra Ovalis. F, G, the Semi-Canal, which incloses the internal Muscle of the Malleus. F, that Part of the Semi-Canal which is situated out of the Tympanum. G, the part which is in the Inside of the Tympanum. H I, the bony Part of the Passage, which goes from the Ear to the Palate, half of it being cut off to shew its Cavity. i, the End of the Tube, which encloses the Muscle of the Stapes.

Fig. II. represents the Incus, on that Side where it is articulated with the Malleus. A, the massy Part of the Incus. B, the short Branch, placed almost in the Front. C, the long Branch. 1, The first Cavity. 2, the Second. 3, The Eminence betwixt the other two Cavities, mark'd by a punctur'd Line.

Fig.

Fig. III. represents the Malleus on that Side where it is articulated, to shew its Eminences and Cavity, which serve for its Articulation. A, its Head. B, its Handle. C, the large Process. 1. The first Eminence; 2. The second Eminence; 3. The Cavity which is between them, mark'd by a punctur'd Line.

Fig. IV. represents the Malleus with its two Muscles, the Eye being plac'd in the Aqueduct, to shew the Compass of the two Muscles, particularly that of the Internal which crosses the Tympanum in its Progress to be join'd to the Malleus. A, B, the Malleus. C, the external Muscle. D, the internal Muscle.

Fig. V. represents the Circumference of the Tympanum, and the fore-part of the Malleus, with its Muscles in their Scituation. A, the Head of the Malleus. B, the Handle. C, the external Muscle of the Malleus. D, its Insertion. E, the internal Muscle. F, the Place where it bends, to be inserted in the Handle of the Malleus, below the external Muscle. GH, the Circumference of the Tympanum; 1. The large Process of the Malleus seen in Front; 2. The thin Process, into which the external Muscle is inserted; 3, 4. The nervous Coat of the internal Muscle, open'd to shew the Muscle.

This

This Figure serves to explain the Manner in which the two Muscles of the Malleus act, in the Contraction and Relaxation of the Membrana Tympani: For their Insertions make it easily be conceiv'd, that when the external Muscle CD, act, alone, the Extremity of the Handle mark'd B is drawn outwards, because the Head of the Malleus rests against the Tympanum at the Place G; but when the two Muscles act together, the Extremity of the Malleus being drawn inwards by the internal Muscle E F, causes a Tension in the Membrana Tympani; because the external Muscle C D, draws, or at least supports the Head of the Malleus, which does not rest against the Tympanum at H, as it does at G.

The first among the little Bones contain-^{3dly, Four lit-}
ed in the Tympanum, which presents itself ^{tle Bones.}
to View, is called the Malleus, because it is ^{The Malleus.}
thicker at one of its Extremities, call'd the Head, and slenderer at the other, which is called the Handle. The Head of this Bone is fix'd in the above-describ'd Cavity, which is in the Top of the Tympanum: At the Side and a little towards the back-part of the Head of this Bone are two Protuberances, and a Cavity for its Articulation with the Incus. The other Part of the

C Bone,

Bone, which is thinner, slenderer, and more elongated, call'd the Handle, increas'd in Bulk by two *Processes*, the largest of which is outermost, and is fix'd to the *Membrana Tympani*: The other which is on one Side, is slenderer and smaller, and receives the Tendon of Muscle. This Handle leans upon, and is fix'd a little obliquely to the *Membrana Tympani*, and growing flat at its Extremity, is more firmly connected to it in that Place: This little Bone is common about the Length of four Lines, and the Diameter of its Head is the Third of its whole Length.

The Incus.

The second little Bone is called *Incus* or *Anvil*, because of its Figure. There are three Parts to be taken notice of in this Bone, *viz.* Its massy Part, which makes up the Body of the Bone, and two Branches which are *Processes*, and seem like Legs to it: The massy Part has two Cavities and one Protuberance to answer the two Protuberances, and one Cavity of the Head of the *Malleus*, being join'd to it by that sort of Articulation which is call'd *Ginglymus*, and which Mechanicks term Hinges. Almost all the massy Part lies conceal'd in the afore-said Cavity, in the Top of the *Tympanum*.

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The shortest of these Branches is placed at the Entrance of the Passage, which goes into the *Processus Mammillaris*, and its Extremity is conceal'd and fix'd by a Ligament in a small Cavity, which is at the Entrance of this Passage. The other Branch, which is the longest, descends perpendicular into the *Tympanum*, and growing curved within, on that Side opposite the *Membrana Tympani*, it forms a little Beak which is articulated, by the Help of a fourth Bone, to the *Incus* which is the third Bone.

The *Stapes*, or Stirrop, is so call'd from *The Stapes*: its exact Resemblance to a Stirrop, having two Branches plac'd upon a flat and oval Basis, pretty like that part of the stirrop upon which we lean our Foot; and at the Top it has a small Head, which is like that Part through which the Stirrop is tied. It is in this Part that there is found a little Cavity, to receive the fourth little Bone. The *Stapes* is situated in such a manner, that its Head being seen in the Front, almost hides its Basis; all the interior Part of the Branches and Basis of the *Stapes*, is form'd hollow like a Gutter. This small Bone is plac'd almost horizontal in this Cavity; its two Branches and its Basis make a

kind of a Frame, to the Bottom of which is fix'd and join'd a Membrane, in the same manner as oil'd Paper is fix'd to a Window-Frame. This Membrane is of a fine Texture, and strewed with a great Number of Vessels. The Basis of the *Stapes* is sunk into the *Fenestra Ovalis*, which it exactly closes up: It is fix'd to that Border which is made in the Form of Foliage, and which has been describ'd before, by the Help of a Membrane, which connects it to it so exactly, that it can't possibly by any Means be sunk down into the Cavity, which is at the Bottom, nor lifted up to the Top of the *Fenestra*, without breaking the Membrane.

The fourth little Bone.

The fourth little Bone is of a very considerable Thickness, it is a little convex on the Side next to the Head of the *Stapes*, and as much, though but a little concave on the Side, which is articulated with the Beak of the *Incus*.

These small Bones are cover'd with a *Periosteum*, and there is no Cartilage found at the Places of their Articulation; but they are firmly connected together only by Ligaments which arise from their Extremities.

The *Malleus* and *Incus* are of a very compact and solid Substance; they only are

are pierced by some *Foraminula*, which afford an Entrance for the Vessels which nourish them. The *Stapes* on the contrary is of a very light and porous Substance. See Plate V. Fig. I, IV, V. VI. VII, IX, and X. Plate VI. Fig. I, III, and IV; and Plate VII. Fig. I, and II.

Two of the three Muscles which are in the *Tympanum* belong to the *Malleus*, the third belongs to the *Stapes*: The First of those which belong to the *Malleus*, may be called External, because it is situated upon the exterior Side of the bony Canal, which passes from the Ear to the Palate, and continuing its Course upwards and somewhat backwards, it enters the *Tympanum*, lying concealed in a very oblique *Sulcus*, which is excavated directly above the Bone which has that Groove in it, into which the *Membrana Tympani* is inserted. This *Sulcus* is that which is seen in the upper part of the bony Circle of the *Fœtus*; which we shall treat of in the Sequel. This Muscle after it enters into the *Tympanum* is immediately inserted into the thin Process of the *Malleus*, which has already been described. See Plate V. Fig. I. Plate VI. Fig. IV, and V; and Plate VII. Fig. I, and II.

4thly, *Three Muscles, two of which belong to the Malleus, viz. The External.*

And the Internal Muscle.

The second Muscle may be called Internal, because it is hid in a bony Semi-Canal, situated in the *Os Petrosum*, which Bone makes one of the *Parietes Tympani*. One Part of this Semi-Canal is without the *Tympanum*, and is contained in the Top of the Passage, which goes from the Ear to the Palate: The other Part, which is within the *Tympanum*, advances as far as the *Fenestra Ovalis*, and forms in this Place a little Ridge, upon which the Tendon of the Muscle runs, as upon a Pulley, passing from one Side of the *Tympanum* to the other, and is inserted into the posterior Part of the Handle of the *Malleus*, a little below the Insertion of the external Muscle, to draw it towards the *Os Petrosum*. The Origin of this Muscle is exactly at the Place where the bony Part of the Aqueduct ends; it is cover'd with a nervous Coat, which forms a Sheath, which accompanies it in all its Course, and firmly connects it to the Semi-Canal. See Plate VI. Fig. I, IV, and V.

And one to the Stapes.

The Muscle of the *Stapes* is hid in a bony Tube, which is formed out of the *Os Petrosum*, almost at the Bottom of the *Tympanum*, from whence this Muscle takes its Origin: It has a large fleshy Belly, which ends suddenly in a very small Tendon,

on, which is inserted into the Head of
the *Stapes*. The Tube which encloses the
belly of this Muscle is about two Lines
long, and is much larger at its End, where
the Tendon of the Muscle passes through
the. See Plate V. Fig. VIII. and Plate
III. Fig. I.

The last Part to be taken notice of in *A Branch of a*
the *Tympanum*, is the small Branch of a *Nerve*.
Nerve which passes behind the *Membrana*
the *Tympani*, which some have mistook for
the Tendon of one of the Muscles which
belong to the *Malleus*; but which is a
branch of the fifth Pair of Nerves, which
shall afterwards be described.

The above-mention'd two *Fenestræ*, *The second Ca-*
have each of them an opening into a *vity of the in-*
Cavity, which is excavated out of the *Os Pe-*
rosum, which is call'd *Labyrinthus*, from *ternal Ear cal-*
being very intricate, because of its ma- *led the Laby-*
ny Windings: This Cavity is divided in- *rinth, is divi-*
to three Parts; The First is that which *ded into three*
may be called the *Vestibulum*, or Entry of *Parts.*
the Labyrinth, because it leads to the two
others; The Second Part contains three
round Canals, which being curv'd in the
Half Circle, I shall in the Sequel call them
the three *Canales Semi-Circulares*; they are
placed on that Side the *Vestibulum*, to-
wards the back-part of the Head: the

Third Part is the *Cochlea*, which is situated on the contrary Side.

1st. The *Vestibulum*.

Which has
nine Foramina.

The *Vestibulum* is a Cavity almost round formed out of the *Os Petrosum*, and about a Line and a half in Diameter: It is situated behind the *Fenestra Ovalis*, and covered on the Inside by a Membrane, furnished with a great many Vessels. There are nine *Foramina* in it, of which one has been already described, viz. the *Fenestra Ovalis*, which forms an Entrance from the *Tympanum* into the *Vestibulum*; the other eight are in the Cavity of the *Vestibulum*. The first leading into the upper Range of *Scala* of the *Cochlea*; there are five more which afford an Entrance into the three Semi-circular Canals, and the two last through which two Branches of the *Portio Mollis* of the auditory Nerve pass.

2^{dly}, The three
Canales Semi-circulares,
viz.

I shall give Names to the three *Canales Semi-circulares* to distinguish them, and shall take those Names from their Situation: The first I call *Superior*, because it takes up the upper Part of the Arch of the *Vestibulum*; the second *Inferior*, because it surrounds its lower Part; and the third, which is placed more towards the Outside, and is situated between the other two, *Medius*.

The *Canalis Semi-circularis Superior* *Canalis Semi-circularis Superior.* passing out of the *Vestibulum*, runs from the fore-part to the back-part, afterwards growing curv'd turns a little from the back to the fore-part, proceeding as far as the Middle of the posterior Part of the *Os Petrosum*, making a little more than a Half-Circle, and there it unites with the *Canalis Inferior*.

The other which I call *Canalis Inferior*, *Inferior.* comes from the inferior Part of the *Vestibulum*, and forms also a little more than a Semi-Circle, and joins itself to the superior Canal, as has been before described. These two Canals being joined together form but one, which advancing forwards a little obliquely, opens into the Middle of the *Vestibulum*.

The third, which I call *Medius*, has its *Medius.* two separate Orifices, and forms no more than its Semi-Circle. The Bore of these Canals is sometimes round and sometimes oval, and is enlarg'd towards their Extremities, like the broad End of a Trumpet.

The six Extremities of these three *Canales Semi-circulares*, form only five Orifices into the *Vestibulum*, since there is one of these Orifices common to both the Extremities of the superior and inferior

Canals, as aforesaid. These Orifices are disposed in such a Manner, that there are two at the Top, two at the Bottom, and one in the Middle of the *Vestibulum*.

The first, to begin from the Top to the Bottom, is the Orifice of the *Canalis Semicircularis Superior*, the other is one of the Orifices of the *Canalis Medius*: These two Orifices are separated near their Entrance into the *Vestibulum*, only by a small bony Ridge, which ends insensibly as it enters into the *Vestibulum*.

As for the two Orifices which are at the lower Part of the *Vestibulum*; the first, reckoning from the Top to the Bottom, is that of the *Canalis Inferior*, and that which is situated above it is the other Orifice of the *Canalis Medius*.

The Orifice which is in the Middle of the *Vestibulum*, and which is the largest of them all, is that which is common to the superior and inferior Canals. See Plate X. Fig. I, IX.

Explanation of Plate X.

Fig. I. represents the temporal Bone twice as large as Nature; it is prepar'd in such a manner that it shews the Cochlea, and the Semi-circular Canals in their natural Situation.

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Fig. VI.

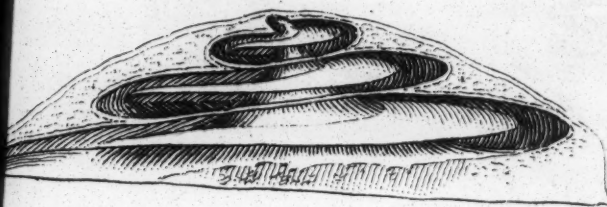


Fig. VII.

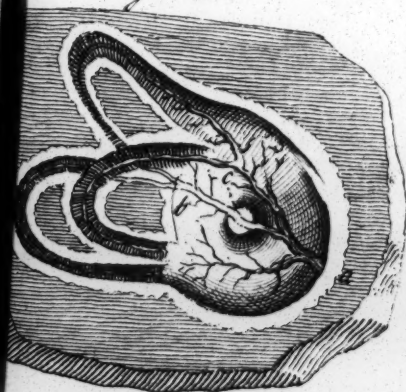


Fig. VIII.



Fig. I.

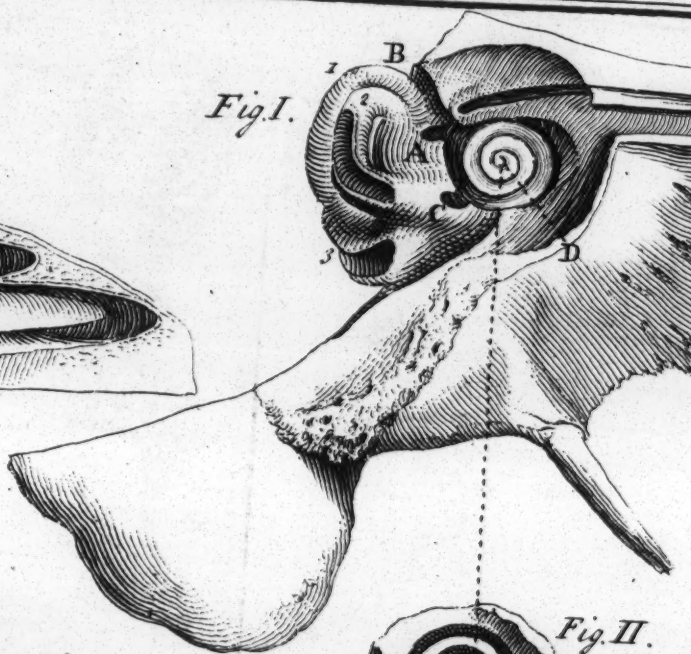


Fig. II.



Fig. IX.

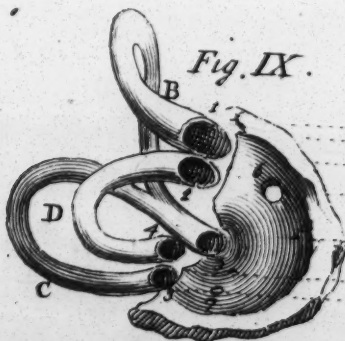


Fig. III.

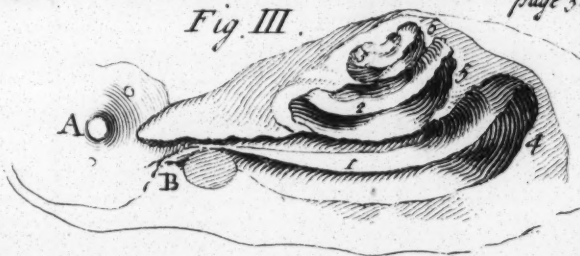


Fig. IV.

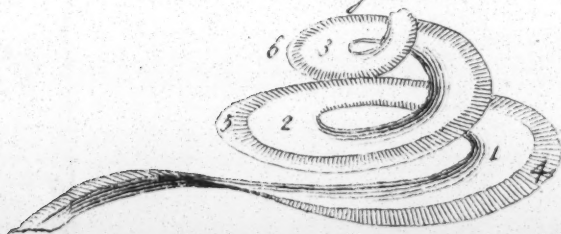


Fig. X.

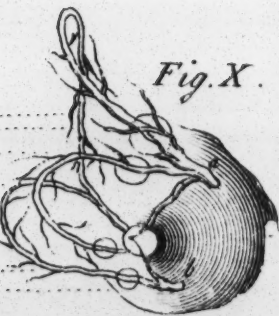
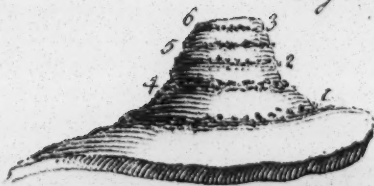


Fig. V.



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ation. A, the Vault of the Vestibulum. B, the Fenestra Ovalis, mark'd by a punctur'd Line. C, the Fenestra Rotunda open. D, the Lamina Spiralis mark'd by a punctur'd Line, divested of the spiral Canal which covers it, and of the Membrane which connects it to the Surface of this Canal. 1, 2, 3, the three Semi-circular Canals in their natural Situation. 1. the Superior. 2, the Middle. 3. the Inferior. The Middle, and the Inferior are open, to shew that they are hollow.

Fig. II. represents the Inside of the Covering of the Cochlea taken off, to shew the Semi-oval Spiral Canal.

Fig. III. represents the Height of the Cochlea much larger than Nature, to show it thus, The fore-part of its Covering only is taken off by a perpendicular Section: This shews how the Lamina makes two Turns and a Half round the Axis, how it is fix'd to the Surface of the Canal which serves as an Arch to it, and how the Sides of this Canal, which are connected to the Axis, become as thin as the Lamina. A, the inferior Portion of the Vestibulum, which is put into this Figure, and only left to shew how the Lamina Spiralis proceeds out of its Cavity, and passes before the Fenestra Rotunda. B, the Fenestra Rotunda clos'd up
C 6 by

by a thin Membrane, like the Membrana Tympani. 1, 2, 3. The two Circumvolutions and a half of the Lamina Spiralis round the Axis. 4, 5, 6, The two Turns and a half of the Spiral Canal.

Fig. IV. represents the Lamina Spiralis in the Air much larger than Nature, with the Membrane which connects it to the Surface of the Canal. 1, 2, 3, The Lamina Spiralis. 4, 5, 6, The Membrane which is fix'd to it, and which is distinguish'd from it by a Line, which is drawn between both.

Fig. V. represents the Axis much larger than Nature, upon which the Traces of the Circumvolutions of the Lamina Spiralis, and of the Spiral Canal are remarkable. 1, 2, 3. The Traces of the Windings of the Lamina Spiralis, which are perforated by a great many Foraminula, which afford a Passage to the Filaments of the auditory Nerve. 4, 5, 6. The Traces of the Side of the Spiral Canal.

Fig. VI. represents the Cochlea standing, and half of it cut perpendicularly off, much like Fig. III. except that all the Bone is here taken away: This Figure is made for the better comprehending that third Figure, and for its Explanation it is sufficient to remark, that the Lamina appears here disengag'd from the Surface of the Canal, that it may shew the Inside of this same Canal, and how

its Sides are elongated to be connected to the Axis.

Fig. VII. represents the Vestibulum and the three Semi-circular Canals open, to shew the Distribution of their Vessels. a, the Branch of an Artery which enters into the Vestibulum. b, a Ramification of this Artery, which passes through the common Orifice of the Vestibulum, and which is distributed into the superior and inferior Canals. c, the Ramification which furnishes the middle Canal.

Fig. VIII. represents the Arteries of the Cochlea, Vestibulum, and three Semi-circular Canals. A, the Fenestra Rotunda. B, the Orifice of the Passage which gives Entrance to the Vessels, which is at the Entrance of the Scala Inferior of the Cochlea; it shews that one Part of these Vessels is distributed into the Cochlea, and the other into the Vestibulum, and the three Semi-circular Canals; these last are represented as in the Air.

Fig. IX. represents a Portion of the Vestibulum and the three Semi-circular Canals in the Air, to shew their natural Situation and their Orifices. A, the Inferior Portion of the Vestibulum. B, the Superior Canal. C, the Inferior. D, the Middle. 1, the Orifice of the superior Semi-

Semi-circular Canal. 2, the first Orifice of the middle Canal. 3, the Orifice of the inferior Canal. 4. the other Orifice of the middle Canal. 5, the common Orifice to the superior and inferior Canal. 6, the first Foramen, which affords an Entrance to one of the Branches of the Portio Mollis. 7, the second Foramen, which affords an Entrance to another Branch of the same Nerve.

Fig. X. represents the Vestibulum, in the same Disposition as in the preceeding Figure, with the Nerves of the three Semi-circular Canals in the Air. a, a Branch of a Nerve, which enters into the Vestibulum by a Foramen mark'd 6, in Fig. IX. It is divided into three Branches, the first of which enters into the Orifice of the superior Semi-circular Canal, the second into the superior Orifice of the middle Canal, and the third which is the least descends to cast itself into the common Orifice. b, the Branch which enters by the Foramen, mark'd 7 in Fig. IX. and is divided into two Ramifications, the Inferior of which enters into the Orifice of the inferior Canal, and the other advances into the common Orifice, and unites with the third Ramification of the Branch mark'd a. These Nerves are represented somewhat larger than Nature.

On that Side of the *Vestibulum* near the ^{3dly, The} Face, opposite to the three Semi-circular Cochlea, in Canals, we meet with the third Part of ^{which two} the Labyrinth, call'd the *Cochlea*, which ^{Things are to} is compos'd of two Parts, viz. Of a ^{be taken no-} Semi-oval spiral Canal, and a *Lamina*, which runs spirally upwards. This *Lamina* follows the Course of the Canal, and separates it into two.

This Semi-oval Canal is excavated out ^{1. The Semi-} of the interior Part of the *Os Petrosus*, ^{oval Canal,} it covers the *Lamina Spiralis* in the Form of a Vault, and which makes a Dint in the Surface of this Bone, which advances forwards into the Inside of the *Tympanum*, opposite to the *Membrana Tympani*: This Dint is elongated and terminates in a small Ridge, which makes the Separation between the two *Fenestræ*, as above-described. The Canal makes two Turns and a half round the Axis, diminishing and growing narrower as it proceeds upwards: Its Sides, which are fix'd to the Axis, diminish so much of their Thickness, the nearer they approach it, that they appear as thin as the *Lamina*.

The *Lamina Spiralis* separates this Ca- ^{2. The Lami-} nal into two Parts, in which it is con- ^{na Spiralis,} tain'd, being fix'd to the Axis by its *Basis*, and by its other Extremity to the Surface of

of the Canal opposite to the Axis, by means of a very fine Membrane, much thinner than the *Lamina*, and of a darker Colour which does not proceed in a plain *Superficies* like the *Lamina*, but turns a little downwards. This Membrane, as it unfolds itself, lines the interior Part of this Canal: It is easy to imagine, that in taking out the Axis from this Vault in the *Cochlea* which surrounds it, there must of Necessity appear four entire Rounds, and two half Rounds, viz. Two Rounds and a half of the Semi-oval Canal, and two Rounds and a half of the *Lamina Spiralis*. This *Lamina* is hard and brittle; its Basis near the Axis is perforated with many oblique *Foraminula* in the same manner as the Axis is; the other Extremity of the *Lamina* is very thin, firm, and tense.

The Canal of the *Cochlea* being thus divided into two *Scalæ* or Ranges of Stairs in the *Cochlea*, built upon the same Axis, one above another, which have no Communication one with another, they have only two separate Orifices, one of which forms an Entrance from the *Vestibulum* into the *Scala Superior* of the double Range; the other, which is the *Fenestra Rotunda*, affords a Passage from the *Tympanum* into the *Scala Inferior*.

Which is fix'd to the Canal by a very fine Membrane,
And which divides this Canal into two.

See

of HEARING.

41

See Plate X. Fig. I, II, III, IV, V,
and VI.

There is an Orifice in the inferior Part of the *Os Petrosum*, below that through which the auditory Nerve enters, which forms a Passage for an Artery and a Vein, which are Branches of the internal Carotids and Jugulars: This is the Entrance of a Canal, which proceeding about the Length of a Line and a half, opens into the *Scala Inferior* of the *Cochlea*, near the *Fenestra Rotunda*. There Vessels entering in this Place divide themselves into a great many Branches, which are distributed to the *Lamina Spiralis*, and to the Membrane that lines the Inside of the Spiral Canal. This Artery also in its Entrance furnishes a considerable Branch to the *Vestibulum*, which as it enters is divided into two Ramifications, one of which is extended on the right Side, and the other on the left. These two Ramifications are commonly subdivided again into two more, one of which enters by the Orifice of the *Vestibulum*, which is common to the superior and inferior Semi-circular Canals, and divides itself into two small Filaments, which are distributed on the Inside of these Canals: the other Branch entering at the superior Orifice of the middle Canal,

And 3dly, The
Arteries and
Veins of the
Cochlea,

And of the
Vestibulum.

nal, re-enters into the *Vestibulum* by its other Orifice. These Ramifications form *Anastomoses* in many Places in the Inside of the *Vestibulum* : The Veins follow the same Course as the Arteries.

4thly, The implanted Air.

Since the two *Fenestræ*, which enter into the Cavities of the Labyrinth, are exactly stopt up, one by the Basis of the *Stapes*, the other by its Membrane, it is easy from hence to conclude, that the Air which is confin'd in this Place can have no Communication neither with that in the *Tympanum*, nor consequently with the external Air ; and this Air is that without doubt which Anatomists have term'd Implanted Air. See Plate X. Fig. VII, and VIII.

The other Parts of the Organ of Hearing, are the Canal of the auditory Nerve.

The Canal through which the auditory Nerve passes is very large. It is form'd out of the middle of the hinder Part of the *Os Petrosum* next the Brain, and proceeding obliquely backwards about the Length of two Lines, it forms an impervious Passage, whose Bottom is partly terminated by the Basis of the *Cocblea*, and partly by a Portion of the Arch of the *Vestibulum* : At the Extremity of this impervious Passage there is a small bony *Septum*, which separates the Basis of the *Axis* from the *Foramen*, through which the

the *Portio Dura* of the auditory Nerve passes.

The *Nervus Auditorius* arises from the *Nervus Auditorius* posterior Side of that Protuberance, which

Modern Anatomists have call'd *Annular*, about the Distance of a Line from a small Lobule of the *Cerebellum*, which is fix'd to the Origin of this *Processus Annularis*:

This Nerve is compos'd of two Branches, the uppermost of which is the largest, and term'd *Portio Mollis*, because it is not only in Reality more tender and soft than that which accompanies it, but also than all the other Nerves of the *Medulla oblongata*, except the Olfactory Nerves. The inferior Branch is called *Portio Dura*, not only because it is more fibrous and compact; but also because it passes out of the *Cranium*, whereas the *Portio Mollis* loses itself in the *Organs of Hearing*. These two Branches run strait and parallel as far as the *Foramen* of the *Os Petrosum*, proceeding about the Length of three Lines; and as soon as they enter into it, the *Portio Dura* passes above the other. It is at the Bottom of this impervious Passage which we have already describ'd, that the *Portio Mollis* is divided into three Branches; the most considerable of which being come to the Basis of the *Axis*, seems to terminate

Is divided into two Branches, viz.

The Portio Mollis.

The Portio Mollis divided into three Branches; the largest of which is distributed into the Axis of the Cochlea.

and

and be lost in this Place: Whereas in reality it enters into those above-mention'd oblique *Foraminula*, and is divided into many small Filaments which are distributed to each Winding of the *Lamina Spiralis*. The Division and Distribution of this Nerve may well be compared with that of the Olfactory Nerve, which being come to the Root of the Nose seems to be terminated in this Place, and many Anatomists have believed that it really terminates here; but if they examine it strictly, they would find the Nerve divided into small Fibres, which are cover'd with the *Dura Mater*, passing thro' the small *Foramina* of the *Os Cribrosum* and entering into the Cavity of the Nostrils, are distributed to the Membrane which lines the *Laminae* of the Nose. See Plate XI. Fig. I, II, and III.

Explanation of Plate XI.

Fig. I. represents the Basis of the Cerebrum divested of all its Vessels, to shew the Origin of the ten Pair of Nerves, which proceed from the Medulla Oblongata; and that Part of the Substance of the Cerebrum, which Mr. Willis call'd its Posterior Lobe, is cut off; i. e. the Incision passes through the

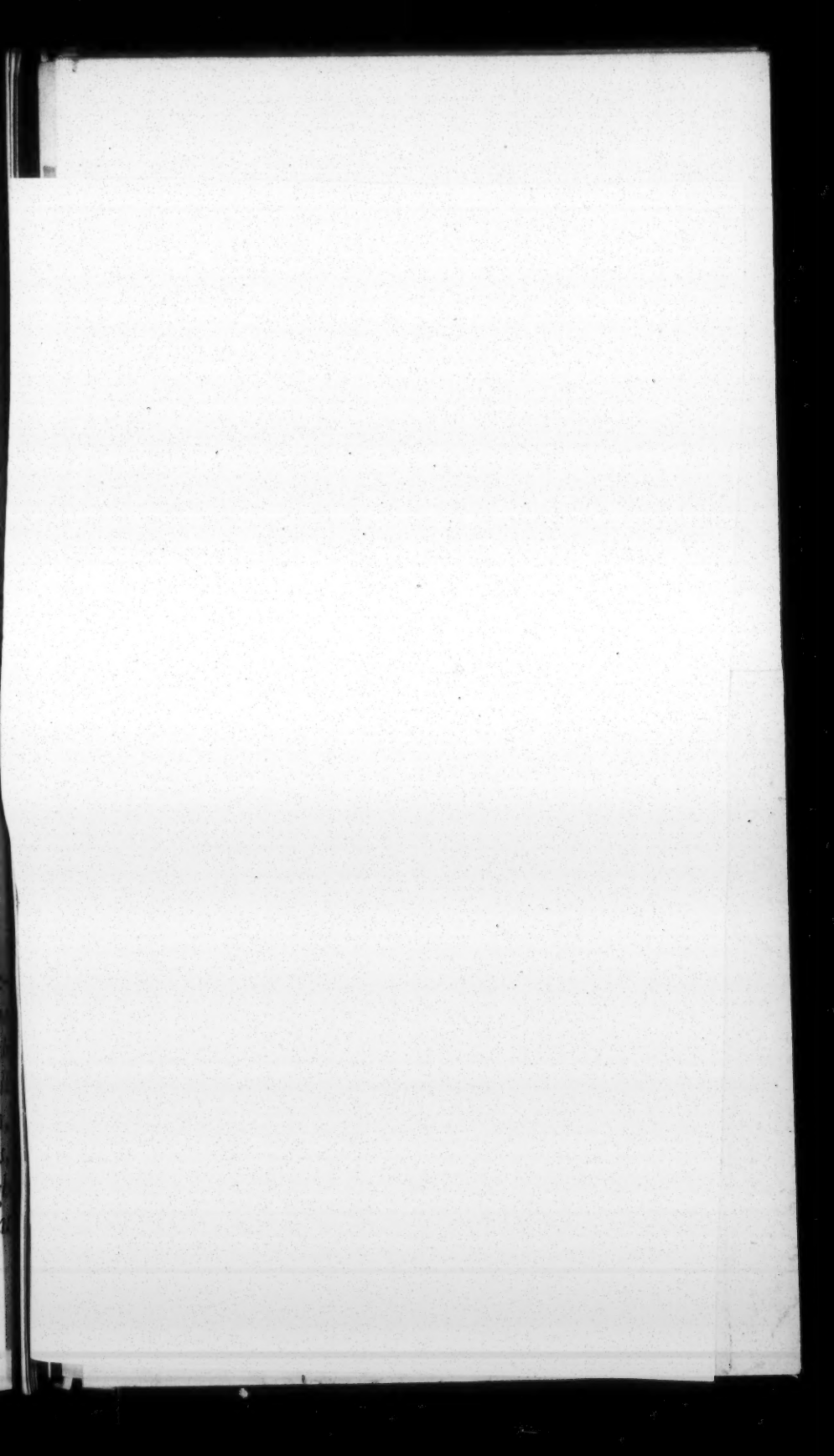


Fig. I.



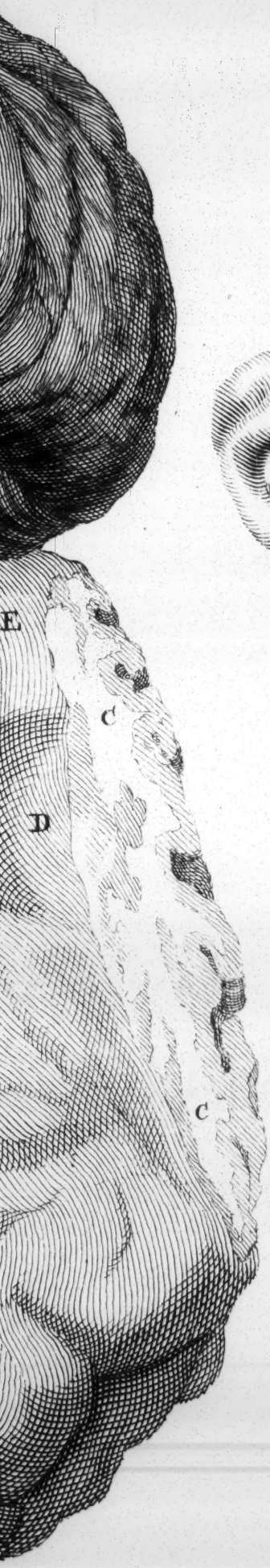


Fig. II.

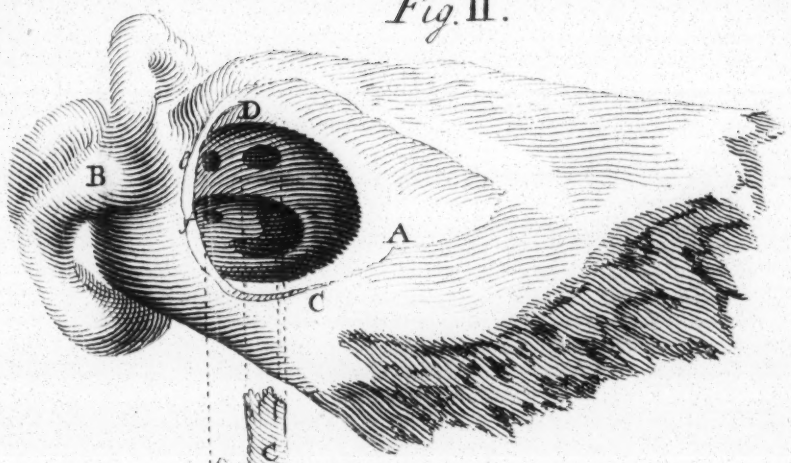
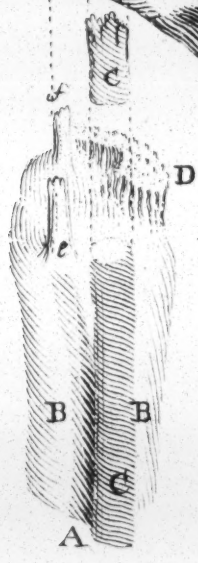


Fig. III.



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that Place, where a great lateral Branch
 of the carotid Artery is sent off upon the
 Substance of the Cerebrum, into the Inter-
 stice of its Lobes : This Incision serves to
 discover the true Origin of the first Nerves,
 and to place the Cerebellum, which in a
 revers'd Brain is always found supported by
 the posterior Lobes, in the same Superficies
 as the Cerebrum ; which is absolutely neces-
 sary to shew the true Figure of the Medulla
 Oblongata, and the Origin of all the Nerves
 which proceed from it. A A, the fore-
 part of the Cerebrum revers'd. B B, the
 Cerebellum. C C, the Place where a
 Part of the Cerebrum has been cut off ;
 this Cut is mark'd but on one Side, but we
 may suppose the same on the other. D D,
 the Corpora Striata, which are the Origins
 of the Medulla Oblongata, their posterior
 Part is here shewn, and a Portion of them
 is cut off with the Cerebrum. E E, the
 Nervorum Opticorum Thalami. F, the
 Medulla Oblongata, whose two Branches
 are united in this Place, although Mr. Willis
 fancied they were divided. G, the Proces-
 sus Annularis. H H, the first Pair of
 Nerves, nam'd the Olfactory, which take
 their Origin from the Basis of the Corpora
 Striata, by a medullary Fibre mark'd h h,
 and which increases in Bulk in the Place
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where they wind about, near the optic Nerves. I I, the optic Nerves, or the second Pair of Nerves, which from their Origin from the Thalami are shewn as far as to their Exit out of the Cranium. K K, the third Pair of the Nerves, call'd Oculorum Motorii. L L, the fourth Pair of Nerves, call'd Pathetici. M M, the fifth Pair of Nerves. N N, the sixth Pair of Nerves. O O, the auditory Nerves, which form the seventh Pair; they are divided from their Origin into two Branches, the largest of which, which is the uppermost, is the Portio Mollis. P P, the eighth Pair of Nerves, which proceed out of the Medulla, below the two Eminencies mark'd y y. Q Q, the ninth Pair of Nerves, which is mark'd but on one Side of the Medulla, and is even placed out of its Direction, for fear of rending the Figure puzzling, on the other Side we have contented ourselves with shewing the Origin. R R, the tenth Pair of Nerves which proceed out of the Medulla Oblongata, which Mr. Willis has confounded with the first vertebral Pair. S, the Medulla cut off at its Entrance into the Vertebrae. T T, the two Nerves which proceed out of the Medulla Spiralis, in the Inside of the Cavity of the Vertebrae of the Neck, and ascend up into the Cranium, to

be united to the eighth Pair of Nerves. u, the Infundibulum. xx, two small medullary Processes, which Mr. Willis has taken for Glands. y y, two Eminences of the Medulla form'd in the Shape of Olives, which Mr. Willis has call'd Corpora Pyramidalia. z z, two small Filaments of Nerves which proceed out of the Medulla, to be united to those Nerves which come from the Spine, and are join'd to the eighth Pair; sometimes two or three of these Filaments of Nerves are found on each Side.

Fig. II. represents the back-part of the Os Petrosum much larger than Nature, and as much of it taken off as was necessary to discover the three Semi-circular Canals, and the impervious Passage, which terminates the Canal of the auditory Nerve, and to shew all the Foramina which we find there. A, the Canal of the auditory Nerve taken off. B, the Semi-circular Canals. C, the Basis of the Axis of the Cochlea, pierc'd by a great Number of small Foraminula, which give Entrance to the nervous Filaments, which are distributed to all the Turnings of the Lamina Spiralis. D, the Entrance of the Canal which incloses the Portio Dura. e, the Foramen which gives Entrance to the Branch mark'd e in Fig. III. another Foramen which gives Entrance to

to the third Ramification of the Portio Mollis, mark'd f, in Fig. III.

Fig. III. represents the auditory Nerve much larger than Nature, which appears as if it were torn off from the Os Petrosum, to shew how it is divided at the Bottom of the Passage. A, the auditory Nerve divided into two Branches. B B, the Portio Mollis. C C, the Portio Dura, part of which is plac'd at the Top of the Figure, to shew the Filaments of one of the Branches of the Portio Mollis; the Trunk of the Portio Dura enters into the Foramen marked D, in Fig. II. D, a large Branch of the Portio Mollis, which is divided in a great many small Filaments which enter into the Foraminula, which are situated at the Basis of the Axis of the Cochlea, and are distributed to all the Circumvolutions of the Lamina Spiralis. e, another Branch of the Portio Mollis, which enters into the Foramen, mark'd e, in Fig. II. f, the third Branch of the Portio Mollis, which enters through the Foramen, mark'd f, in Fig. II. See the Distribution of these two last Branches in Plate X. Fig. X. the Branch e, is there mark'd by the Letter a, and the Branch f, by the Letter b.

The

The two other Ramifications of the *Portio Mollis*, are for the use of the *Vestibulum*. The most considerable of these two Branches into the *Vestibulum*.

two Branches run in at the Entrance of the Canal of the *Portio Dura*, and afterwards enters obliquely into a particular *Foramen*, which opens into the Arch of the *Vestibulum* at the side of the Orifice of the superior Canal of the *Cochlea*: This Ramification, as it enters, forms a sort of a Tuft, one Part of which proceeds into the Orifice of the superior semi-circular Canal, and into that of the anterior or middle Canal, joining them together, and partly shutting them up; afterwards it furnishes a small nervous Filament to each of these Canals, joining it self to an Artery which is distributed to these Parts, and proceeding every where with it in the same Course; the other Part of the Tuft is elongated at the bottom of the *Vestibulum*, and produces a small Twig, which enters into the common Orifice.

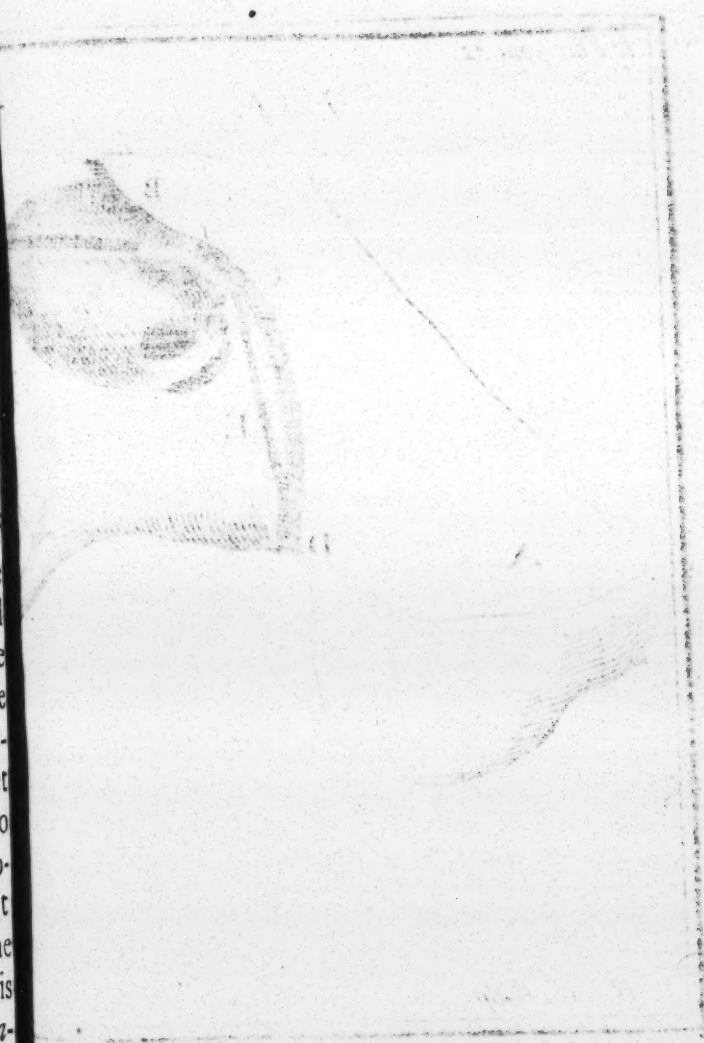
The second Branch of the *Portio Mollis*, which is destin'd for the use of the *Vestibulum*, enters into a very oblique *Foramen*, which opens a little below the above describ'd Branch: This Nerve at its entrance into the *Vestibulum*, is divided

vided into two small Twigs; one of which enters into the Orifice of the inferior Canal; which is situated at the bottom of the *Vestibulum*, and the other ascends towards the common Orifice. All these small Ramifications of Nerves, have a Communication with one another. See Plate X. Fig. X.

The Portio
Dura,

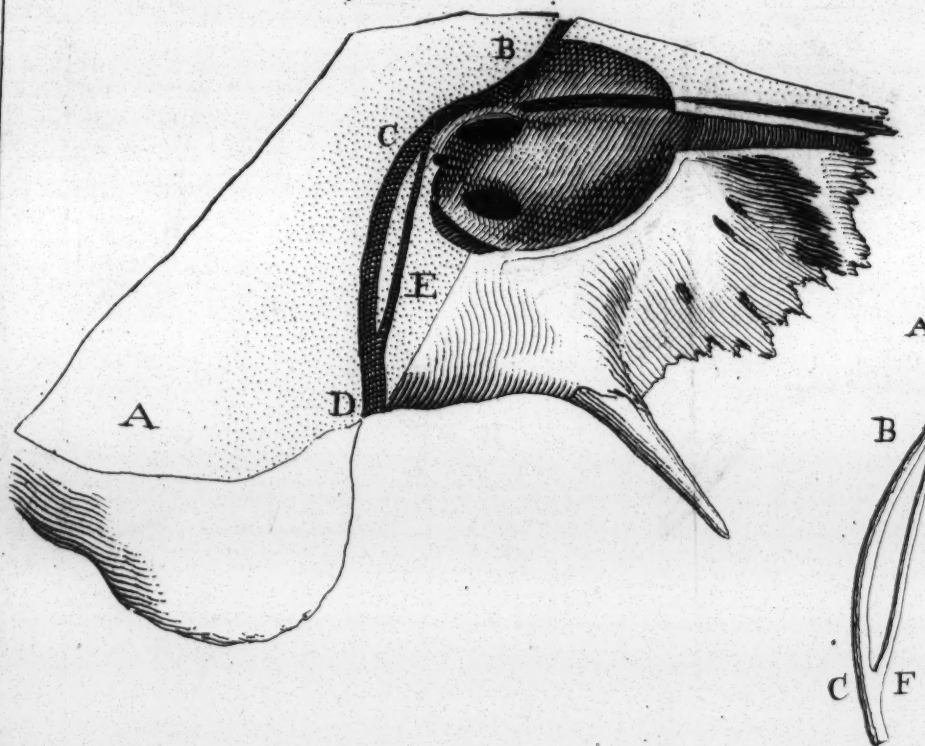
The *Portio Dura* enters into a *Foramen*, situated near the upper Part of the *Fundus* of that impervious Passage, which we have already describ'd. This *Foramen* is the entrance of the bony Canal, which is form'd out of the *Os Petrosum*, running obliquely towards the *Tympanum*, into which it does not penetrate, but only insinuates it self into the Surface of the *Os Petrosum*, which makes one of the *Parietes* of the *Tympanum*. This Canal proceeding down to the Top, and by the Side of the *Fenestra Ovalis*, and to the upper Part of the little Canal, which incloses the *Musculus Stapedis*, descends yet lower; and having proceeded about two lines and an half, being all along cover'd by the *Os Petrosum*, it passes out thro' a *Foramen*, which is between the *Mastoid* and *Styloid Processes*. This Nerve before it protrudes out of its *Foramen*, receives a Ramification from a Nerve

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Fig. I.

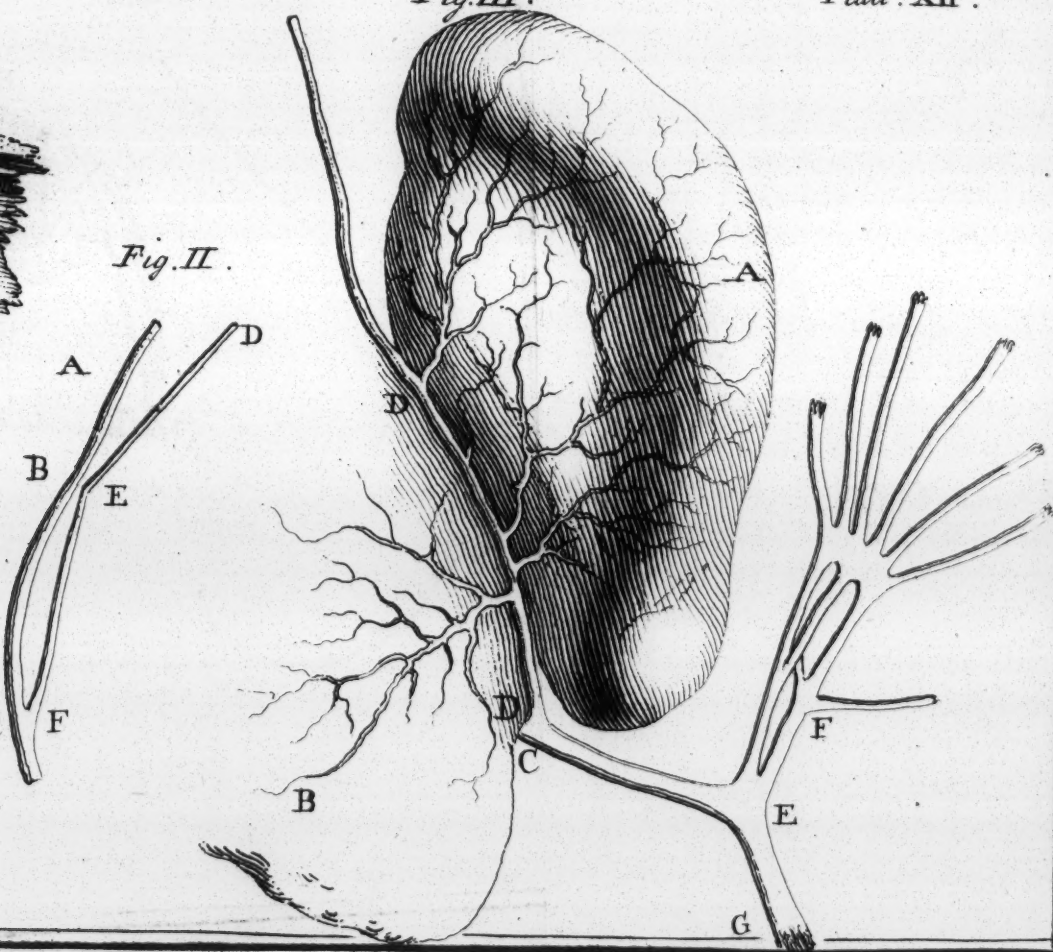


B. Cole. Sculp.

Fig. III.

Plate. XII.

Fig. II.



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Nerve of the fifth Pair, which passes behind the *Membrana Tympani*, which we shall describe in the Sequel. This same *Portio Dura* at its Exit out of the *Fora-* Which produces as it passes out of the Cranium, a Ramification ascending towards the back part of the Ear, is expanded over all the Parts of the exterior Ear, and near the *Processus Mammillaris*. It furnishes many other Branches which are distributed to other Parts, of which we shall treat at the End of this Description. See Plate XI. Fig. II. Plate XII. Fig. I, II, and III.

Explanation of Plate XII.

Fig. I. represents the Surface of the *Os Petrosum*, twice as large as Nature, to shew the bony Canal, thro' which the *Portio Dura* passes, and that thro' which the *Chorda Tympani* descends to be join'd to the *Portio Dura*. A, the *Processus Mammillaris*. B, C, the bony Canal which is the *Tympanum*. C, D, part of the same Canal which is situated without the *Tympanum*, and which is excavated out of the *Os Petrosum*. Its Extremity lies between the *Processus Mammillaris* and *Glyoides*. E, the little Canal of the *Os Petrosum*, thro' which the small Nerve of

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the Tympanum passes to be join'd to the Portio Dura.

Fig. II. represents the Portio Dura bare, extracted from its Canal, with the little Chorda which crosses the Tympanum. A, B, part of the Portio Dura, which is inclos'd in the Tympanum. B, C, part of the Portio Dura, which is conceal'd in the Os Petrosum. D, E, that part of the Chorda which crosses the Tympanum. E, F, part of the same Chorda, which passing out of the Tympanum, hides it self in the little Canal, mark'd E, in the first Figure of this Plate, and which is join'd to the Portio Dura. F, the place where this little Nerve joins with the Portio Dura.

Fig. III. represents the Ear revers'd, to show the Ramification of the Portio Dura, which is distributed upon it. A, the Ear revers'd. B, the Processus Mammillaris. C, the Trunk of the Portio Dura, passing out of the Os Petrosum. D, D, the first Ramification of this Nerve which ascends up the back Part of the Ear, and distributes—a great many Filaments to it, and to the Processus Mammillaris. E, the Division of the Portio Dura into two Branches. F, the superior Branch. G, the inferior Branch.

* The little Nerve which crosses the *Chorda Tympani*, takes its Origin immediately from a Branch of the fifth Pair, which proceeding downwards, is distributed on the Side of the Tongue; afterwards this Nerve reascends up to the exterior Side of the bony Canal of the Aqueduct, and following the Course of the external Muscle of the *Malleus*, upon which it is plac'd, it enters into the *Tympanum* through the same *Foramen*; afterwards it repasses under the Tendon of the internal Muscle, and descending obliquely backwards, it leans upon the *Membrana Tympani*, and passing before the long Branch of the *Incus*, it comes out of the *Tympanum*, running into a small Canal, which is form'd out of the *Os Petrosus*, and joins to the Trunk of the *Portio Dura*, a little before the *Portio Dura* is protruded out of its Canal. It is this small Thread of a Nerve, which Anatomists have consider'd as the *Chorda Membranæ Tympani*, and which they fancied might cause some Sound in communicating its Agitations to this *Membrane*, in the same manner as a Cord does, which they put upon a Skin of a Drum. But although it is true, that this *Chorda* touches the *Membrana Tympani*,

pani, if we but examine its Structure, we shall soon discover its Use. For besides its Origin, which plainly makes it appear that it is a Nerve, its distribution leaves no room to doubt of it ; there being no Nerve, which is distributed either to the Muscles or the *Officula*, or to the other Parts which are contain'd in the *Tympanum*. See Plate VII. Fig. I, and II. Plate XIII. Fig. I. and Plate XII. Fig. I, and II.

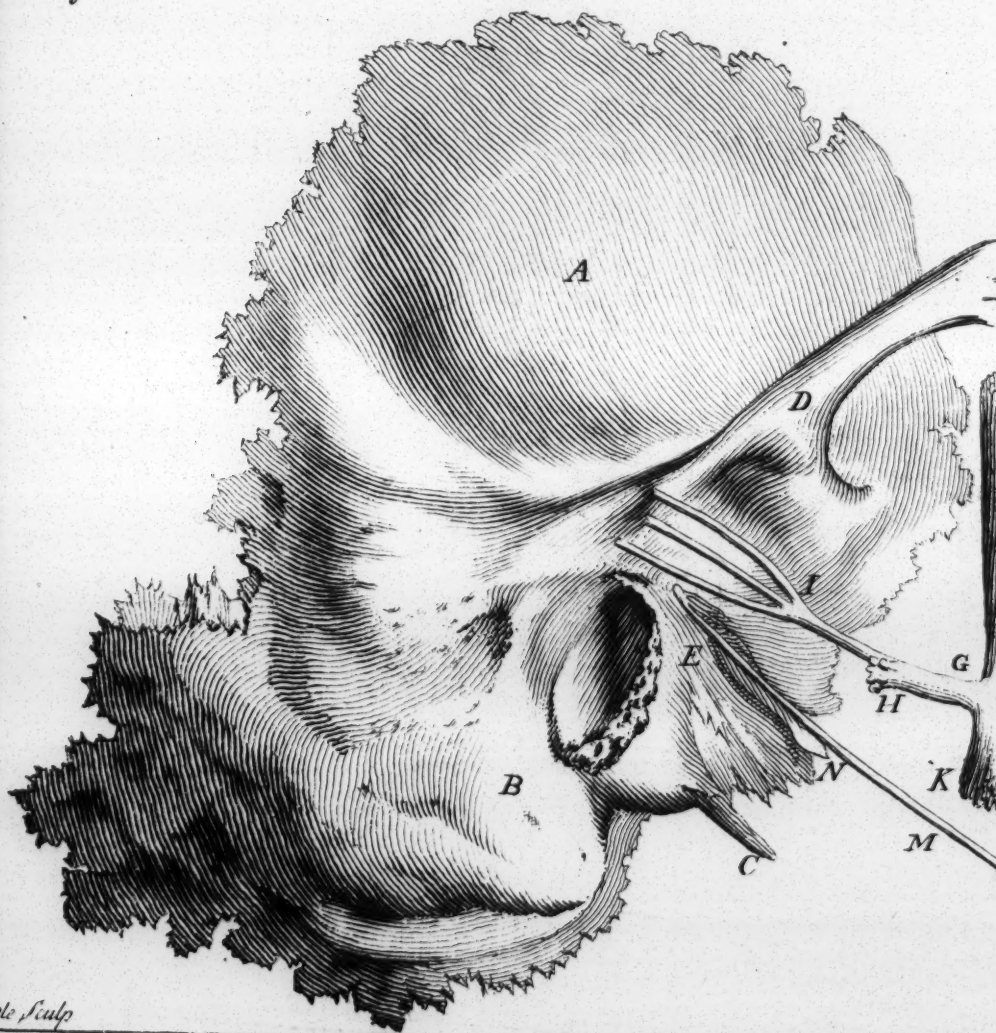
Explanation of Plate XIII.

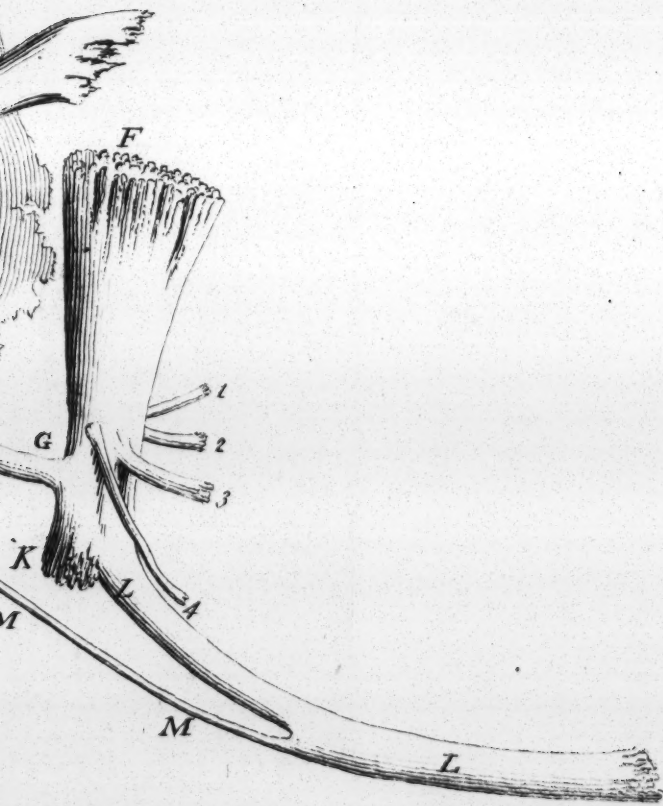
This represents the whole temporal Bone as large as Nature, somewhat revers'd, and the under Part shewn, with the Branch of the fifth Pair of Nerves, which is distributed to the lower Jaw, to shew the Origin and Course of that small Twig of a Nerve, which is call'd the Chorda Tympani, and the distribution of another Ramification of this same Nerve, which goes to the external Ear.

A, the scaly Part of the temporal Bone. B, the Processus Mammillaris. C, the Processus Styloides. D, the Zygomaticus. E, the Passage which goes from the Ear to the Palate. F, the Branch of the fifth Pair call'd the inferior maxillary Nerve, because it is particularly distributed to the lower Jaw, and to the Part which
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surrounds it. 1, 2, 3, 4. Four Ramifications that this Branch furnishes immediately after its Exit from the Cranium, the 1. of which goes to the temporal Muscle. 2. to the external Masseter. 3. to the Buccinator, and to the Glands of the Cheek. 4. to the Pterygoideus internus. G, another Ramification which it also sends off at its exit. H, a Branch of this Ramification, which goes to join the Ramification of the Portio Dura, mark'd 6, in the XVIth Plate. I, the Distribution of the Ramification G, to the external Ear, the Branches of which are cut off. K, the Branch which enters into the lower Jaw cut off. L, L, the Branch which goes to be distributed to the Sides of the Tongue. M, M, a Ramification of this Branch which ascends over the bony Part of the Passage of the Aqueduct, and enters into the Tympanum; and this is what is call'd the Chorda Tympani. N, the external Muscle of the Malleus in its Situation.

Lastly, The second vertebral Pair sends forth a considerable Branch, which goes up to the Ear: It creeps under the Skin, the Length of the *Musculus Mastoideus*, and of the parotid Gland, and parts into three Branches near the Ear, one of

The second vertebral Pair, furnishes a Branch to the Ear.

which is expanded upon the back Part, and upon the End of the Ear, and the third distributes its Fibres into the cartilaginous Passage.

It is here proper to take notice, that Mr. *Willis* makes this Branch of a Nerve proceed from the first vertebral Pair: The Reason of this is, that he supposes that the tenth Pair of the Nerves of the *Medulla Oblongata* passes out no where else but between the first and second *Vertebra*, and so he reckons for the first Pair of the *Medulla Spinalis*, that which issues out into the *Interstitia* of the second and third *Vertebrae*: But the Reason of this Error proceeds from his not knowing the Egress of the tenth Pair, which he has confounded with the first vertebral Pair; tho', these two Nerves have different Origins, Exits, and Distributions. See Plate XIV. Fig. I.

Explanation of Plate XIV.

A, the *Processus Mammillaris*. B, the back Part of the Ear. C, the Trunk of the second vertebral Pair. 1, 2, 3, 4, 5, 6, 7. Many Branches cut off, the this Nerve sends to the neighbouring Muscles, and to the vertebral Nerves. D, I

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the Branch of this Nerve, which ascends up to the external Ear. E, the Branch which is lost in the Lobe of the Ear, and in the cartilaginous Passage.

After having explain'd the Structure of the Ear, in Subjects of eighteen or twenty Years old, we thought it necessary to take notice, in what it differs from the Ear of a *Fœtus*.

There are many particular Things in the Ear of a *Fœtus*.

1. The bony Canal of the auditory Passage is, in the *Fœtus*, nothing but a pretty hard Membrane, join'd by one of its Extremities to the cartilaginous Passage, and by the other it adheres to the *Membrana Tympani*, by the help of a Groove in the bony Circle, which we are going to describe: This Passage, which in Adults is about five or six Lines long, is not above a Line and a half in length; and what appears to us of it, is really nothing else but what serves to form that part of the Canal, which grows flat towards the *Fundus*. See Plate XV. Fig. I.

1. That Part of the auditory Passage, which is bony in Adults, is nothing but a Membrane in the *Fœtus*.

Explanation of Plate XV. which represents many Parts of the Ear of a *Fœtus*.

Fig. I. represents the Ear of a Child one Year old. A, the upper Part of the Ear.

Ear. B, its cartilaginous Passage. C, the Membrane which connects the cartilaginous Passage to the bony Ring, and which indurates afterwards to form the beginning of the bony Passage of the Ear. D, the bony Ring. E, the Processus Zygomaticus.

Fig. II. represents the forepart of the temporal Bone of a Foetus. A, the scaly Part, whose small bony Fibres are easily distinguish'd, as they are also in all the other Bones which compose the Cranium of a Foetus. 2, 3, the Sides of its Circumference, which are yet Cartilaginous. B, the Processus Zygomaticus. C, the Membrana Tympani. D, the bony Ring which receives the Membrana Tympani. E, the Processus Styloides, which is as yet cartilaginous. F, the Processus Mammillaris, which is yet very small. 4, the Foramen, thro' which the Portio Dura passes out. G, this Letter marks an obscure Line, which is the Place where the scaly Part is separated from the Processus Mammillaris; these two bony Pieces are exactly united in Adults. H, the Canal which incloses the internal Carotid. I, the Foramen where the Tube which goes from the Ear to the Palate is connected.

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Fig.

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Fig. 2.

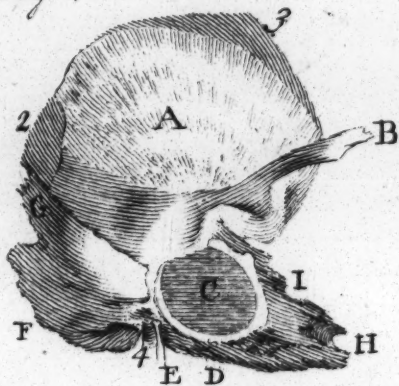


Fig. 1.



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Fig.3.



Fig.5.



Fig.4.



Fig.6.

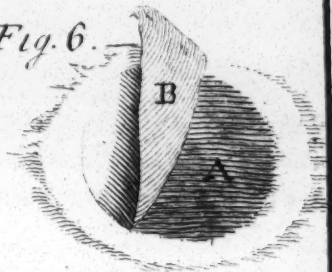
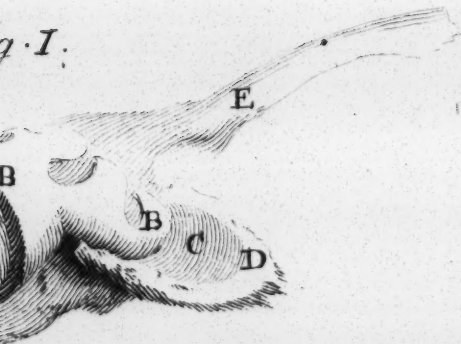


Fig.1.



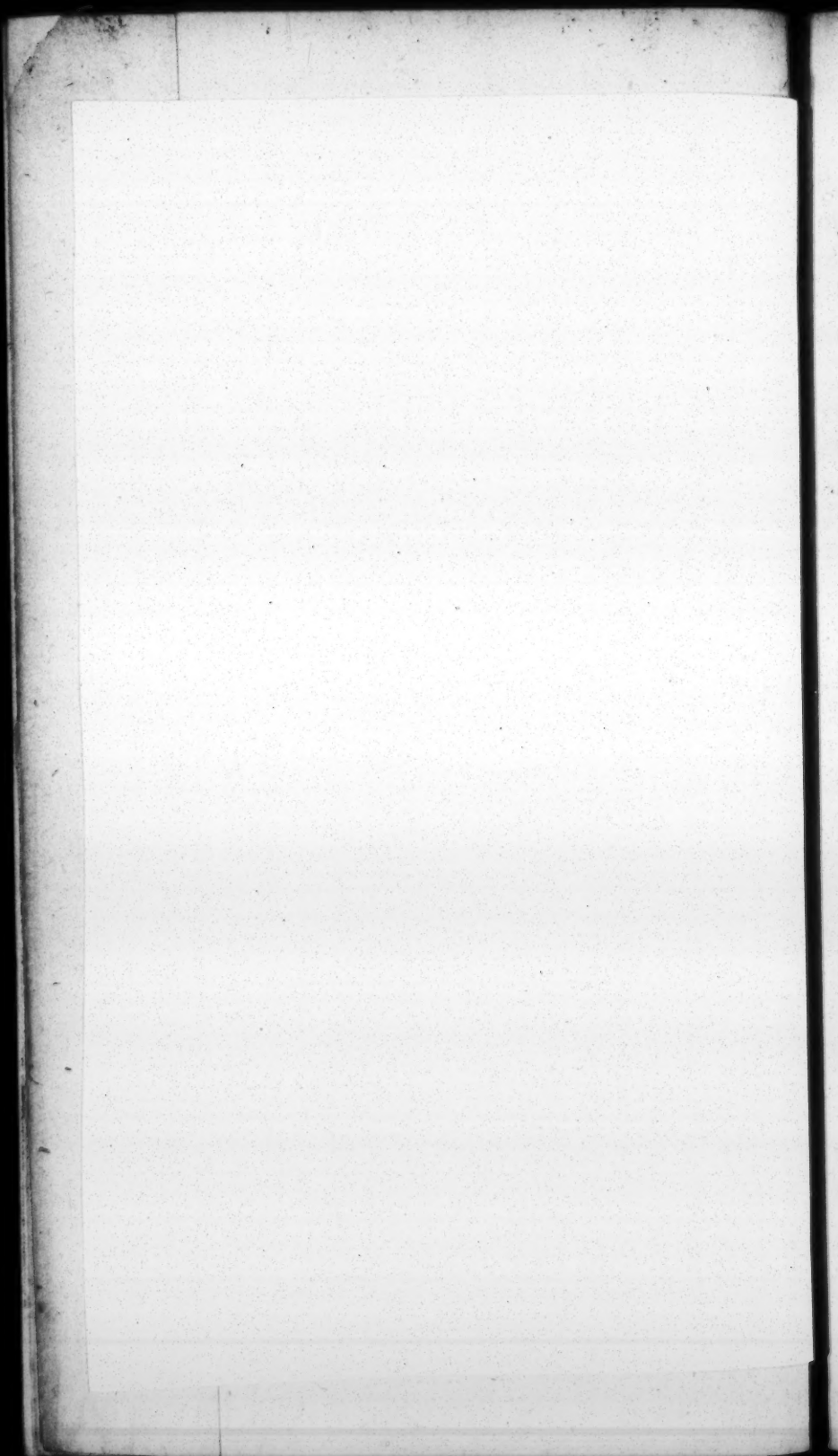


Fig. III. represents the back part of the temporal Bone. A, the scaly Part. B, B, the Place where it separates from the rest of the Os Petrosum. C, the superior Semicircular Canal, which is seen without any Preparation. D, the Inferior. E, the Place of their Communication. F, A considerable Fossa, which is situated under the superior Canal, and which is fill'd up and effaced as the Foetus grows older. G, a Foramen, which is in the Passage of the Portio Dura. H, the Foramen of the auditory Nerve.

Fig. IV. represents the bony Ring, leaning a little to shew the Groove. A, the bony Ring leaning on one Side.

Fig. V. represents the same Ring, leaning in another manner, to shew the rest of its Groove.

Fig. VI. represents the Membrana Tympani, twice as large as Nature, half of it discover'd from a Membrane, which covers it. A, the Membrana Tympani. B, a mucilaginous Matter indurated into a Membrane which covers it in the Foetus.

In the Foetus, we find a Circle which ^{2.} There is a plac'd exactly above the Entrance of Circle. the Tympanum: this Circle is easily separated from the Os Temporum; and may plainly be seen with the Membrana Tym-

pani, when the Ear and auditory Passage is remov'd.

Which is not entire.

This Circle is broke off about half a Line in its upper Part, near the Place where the Head of the *Malleus*, and the massy Part of the *Incus*, are conceal'd in the *Tympanum*; this interruption is found in Adults, as we have said before, and in this Place the *Membrana Tympani* is directly fix'd to the Edge of the Extremities of the bony Canal, belonging to the external Ear.

It is hollow in the Inside like a Gutter.

In the Inside of this Circle, there is a small Cavity, which runs hollow through its whole Circumference, which forms the above-mention'd Groove, in which the *Membrana Tympani* is inchas'd. We must also take notice of a small Sinuosity in its superior Part, upon which the external Muscle of the *Malleus* runs: This Sinuosity is also found in Adults.

This Circle is united to the bony Canal in Adults.

Although this small Circle is easily distinguish'd, and separated in new-born Infants, yet it disappears in Adults, and forming but one Body with the bony Canal, it is impossible to separate it. One may distinguish it in Children of three or four Years old, but it is so strongly fix'd to the temporal Bone, that it is not to be separated from it. We must take notice that

that it begins to join by its two Extremities, and insensibly through the rest of its circumference.

There is no room to doubt, but that *It has the* the Groove into which the *Membrana* same Plan, *Tympani* is fix'd, is the same as the Ca- both in the *Fœtus* as in the Adult. *Membrana Tympani* has constantly the same Situation, and the same Plan in the *Fœtus*, which it has in the Adult. See Plate XV. Fig. IV.

3. The Passage which goes from the Ear to the Palate, which in Adults is partly bony, and partly cartilaginous, is almost entirely membranous in the *Fœtus*, and its bony Part becomes insensibly ossified, as the *Fœtus* advances in Age, in much the same manner as the bony Canal of the auditory Passage does. *3. The Aqueduct almost entirely Membranous.*

4. During the Time, the *Fœtus* remains in the *Uterus*, the *Membrana Tympani* is cover'd with a mucilaginous Matter, which indurates into a *Membrane*, but afterwards it disappears. See Plate XV. Fig. VI. *4. The Membrana Tympani is cover'd with a mucilaginous Matter.*

Besides these, in the posterior Part of the *Os Petrosus*, there are some pretty remarkable Differences to be seen.

The *Canalis semi-circularis Superior* 5thly, The superior Semi-circular Ca-

nal, and a Portion of the Inferior are visible, without any Dissection. and seen almost without any Preparation, as may also a Portion of the *Canalis Semicircularis Inferior*, at the Place where it communicates with the inferior.

6thly, There is a Fossa and a Foramen, in the *Os Petrosum*. 2. Under the superior Canal, there is a considerable Fossa to be seen, which disappears as the Child grows older: And there is besides, a Foramen in the upper Part of the *Os Petrosum*, and in the Passage of the *Portio Dura*, which is very remarkable in the Fetus, and which is also found in People of a very advanc'd Age, but is much more minute in them.

7thly, The scaly Part of the temporal Bone is separable from the *Processus Mammillaris*, which is very minute. 3. The scaly Part of the *Os Temporum* is separated from the *Os Petrosum*, the *Processus Mammiformis* is very small. As for the other Parts of the Ear, there is no remarkable Difference between them. See Plate XV. Fig. I, II, and III.

We shall here take notice, that the small Bones of the Ear, the Semi-circular Canals, and the *Cocblea* are of the same Form, and very near of the same Size, in new-born Children, as they are in Adults: So that Age serves only to strengthen and render them firmer.

To finish this Description, there remains nothing to be taken notice of, but some other Ramifications which the *Portio Dura* sends forth. After it hath furnish'd a Branch

Branch which goes to the Ear, it proceeds about the Length of four or five Lines without any Division; after this, it is divided into two considerable Branches, the Superior of which is many times divided and reunited, as it ascends over the Masseter Muscle, and crossing the Parotid Gland, at last forming a Figure like a Goose's Foot, it is commonly subdivided into seven other Ramifications; the first five of which ascend obliquely, and are distributed to the Muscles of the Forehead, the Temples and Eye-lids. Some of these Ramifications being spread over the *Os Mala*, pass through particular *Foramina*, into the Orbit: The sixth Branch passing over the middle of the Masseter Muscle, receives a considerable Branch from the fifth Pair, which we shall afterwards describe; it furnishes some Branches which accompany the salivary Duct, and which embrace it in many places, and it is subdivided upon the Middle of the Cheek, into a great Number of small Filaments, which are distributed to the Muscles of the Nose, and upper Lip. The Seventh is destin'd for the Use of the Muscles of the lower Lip. Lastly, many Ramifications

Branches, which are divided into many Ramifications.

The Ramifications of the first Branch, are distributed to the Muscles of the Forehead, Temples, and Eyelids.

And pass into the Orbit.

They also go to the Muscles of the Nose and Lips.

And to all Integuments of the Face. cations of all these Branches, are lost in the outward Integuments of the Face.

The Ramifications of the second Branch are distributed to the Muscles which are under the Jaw.

The inferior Branch proceeds downwards under the Angle of the Jaw, and is divided into many little Twigs, which are distributed to the Muscles that are cover'd by the Jaw. See Plate XVI. Fig. I.

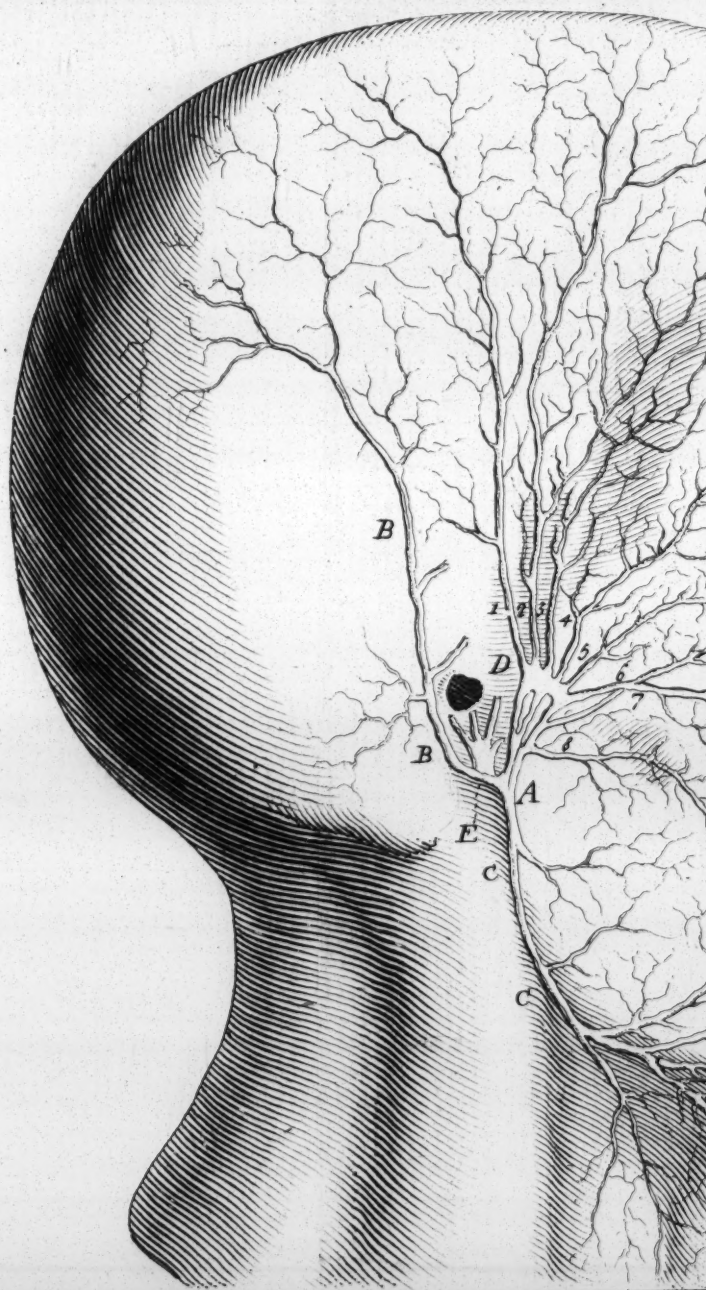
Explanation of Plate XVI.

It represents the Portio Dura, in the different Parts of the Face. A, the Trunk of the Portio Dura, which proceeds out of the Cranium thro' the Foramen, which is between the Processus Mammillaris and Styloides. B, B, a large Ramification, which it furnishes to the external Ear, some Branches of which are cut off, which appear whole in Fig. III. Plate XII. C, C, the inferior Branch which is distributed to the Chin, to the Muscles, which are situated under the Jaw, and to the Integuments. D, the superior Branch, which immediately divides into the Shape of a Goose's Foot. 1, 2, 3, 4, 5, five Ramifications of this Division, which are distributed to the Muscles of the Temples, Forehead, and Eyelids. 6, the Ramification of this Division, which expands it self over the Middle of the Cheeks, and

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B. Cole. Sculp.



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and which is enlarg'd by the Branch of the fifth Pair, mark'd 7, 8, the last Ramification of this Division, which furnishes Twigs to the Musculus Buccinator, and to those of the Lips. 9, 9, two small Filaments, which appear as if they were cut off, because they sink into the Orbit thro' particular Foramina, which are in the Os Malæ. All these Ramifications furnish a very great Number of Filaments to all the Integuments of the Face, we must suppose them cut off in taking off the Integuments. E, the Branch of the fifth Pair, mark'd G in the Plate XIII, from whence a small Branch. 7, passes out, which is united to the Ramification, 6, of the Portio Dura. The other Branches being cut off, which are distributed to the external Ear, and to its Passage, may be seen in the same Plate, i. e. the XIII.

One of the Ramifications from the Trunk of the fifth Pair call'd the Maxillary, immediately at its Egress out of the Cranium, sends off many Branches, one of which passing under the Processus Condylodes of the Jaw, advances forwards, and ascending above the Jaw, very nigh the Place of its Articulation, sends forth a Filament, which passes over the Masseter Muscle, and is united to that Branch of the

The fifth Pair furnishes a Branch to the Portio Dura.

the *Portio Dura*, which spreads it self over the middle of the Cheek. All the rest of this Branch is divided into many Ramifications, which are distributed to the cartilaginous Passage, to the Ear, and to the parotid Gland. Sometimes this Communication is made by a double Branch. Mr. *Willis* and all the modern Anatomists after him, have advanc'd that the eighth Pair furnishes a Branch, which is join'd to the Trunk of the *Portio Dura*, at its Egrefs out of its *Foramen*: I have examin'd many Subjects in hopes of finding this Branch, but never could meet with it; and I can scarce believe Mr. *Willis* has ever seen it but in Brutes, where this Communication is always to be found, and is form'd before the *Portio Dura* proceeds out of its Canal.

End of the First Part.



OF THE
ORGAN
OF
HEARING.

PART II.

*Containing the Use of the Parts
of the Ear.*



AFTER having given a pret-
ty exact Description of all
the Parts of the Ear, to ren-
der this Treatise more use-
ful, I thought my self ob-
lig'd to accompany it with some Re-
flections, and to draw from the Mecha-
nism

*The Mechan-
ical Structure
of the Organs
of Hearing,
serve to disco-
ver the Use of
them.*

nism of these Parts, some Consequences by which we may be able to explain their Use, and the Manner by which we are made sensible of different Sounds and Noises. As it is a very important Subject, and appear'd to me to be very nice and difficult, I wou'd not trust entirely to my own Judgment, and I confess that I am oblig'd to Mr. *Mariote* for a great Part of what will here be found curious; nevertheless, I must not expect that what I am going to treat of, will be well receiv'd by every body. My Conjectures appear probable to me, but other People may be of a different Opinion. However it happens, I shall think I have succeeded very well; if by this Essay I may induce them to give us something better

The external Ear performs the Office of the Trumpet, which deaf People make use of.

I shall follow the same Order that I did in my Description, and therefore I consider the external Ear as a natural Trumpet, whose neat and smooth Cavity serves to amass the Sound, and consequently renders its Impression stronger upon the other Organs of Hearing. Experience favours this Opinion, in that, those People who have their Ears cut off, can't hear so well, and are oblig'd to make Use of the Palm of their Hand, or of a speaking Trumpet to supply this Defect;

and

and also for this Reason, Brutes, as Deer and Hares, always turn their Ears that way from which the Noise comes, that they may hear the better. Some say that the directions of Sound, insinuating themselves into the Folds of the Ear, there form many Refractions before they come to the *Concha*, and that these repeated Refractions serve to increase the Impression upon the other Organs; as it happens in a Semi-circular Vault, that the Rays of the Sound being refracted to equal Angles, the Length of the Circumference of the Vault, at last pass from one end to the other, by many great and small Refractions.

Its Folds serve to augment the Force of the Air, which acts upon the Organs by the Refractions which they cause.

The Motion of the Muscles of the external Ear, is very obscure; but they seem to be design'd for the Contraction and Dilatation of the *Concha*, according to the Force or Weakness of the Undulations of the Air.

The Muscles of the external Ear, serve to contract and to dilate it. The Obliquity of the Passage, is proper to preserve

The Obliqueness of the auditory Passage serves not only to defend the *Membrana Tympani* from the Injuries of the Air, but also this Obliquity affords a larger Surface to the Passage, and is the Cause that there are more Refractions made there, and this may contribute to render the Impression stronger.

the Membrana Tympani from the Injuries of the Weather. And to render the Vibrations stronger, by doubling its Refractions.

The Refractions.

*The Wax stops
extraneous
Bodies, which
might impair
the Membrana
Tympani.*

The Wax, or sort of Glue, which is found in the anterior and cartilaginous Part of the auditory Passage, stops any Filth and Insects which else might enter into the Ear, and which wou'd be a sure Cause of impairing the *Membrana Tympani*.

But if this Wax has its Uses, it has also its Inconveniencies, so that if we don't take care to clean our Ears, this glutinous Matter will be amass'd in it in too great a Quantity, and growing thick by its Detention, will at last be a means of obstructing the Undulations of the Air from coming to the *Membrana Tympani*. It is not long since, that searching out the Cause of Deafness in a Person, who had been afflicted with it many Years before his Death, I found in the auditory Passage, about two Lines from the *Membrana Tympani*, a small Pellet, which was soft and pretty thick with a considerable Quantity of Filth indurated, collected before it, and I don't doubt but that this sort of Deafness is very common.

*It may also be
prejudicial to
the Ear,
when it is too
thick, and in
too great a
Quantity.*

We have taken Notice, that the cartilaginous Passage which is broke off in many Places, forms a sort of a little Tongue, which is at the Extremity of the Cheek before the *Concha*, and directly

at the Entrance into the auditory Passage. This little Tongue hinders the Refractions which are made in the Inside of the *Concha*, from escaping out of this Cavity, making them pass more exactly to the Inside of the auditory Passage: It seems also to be of Use in stopping up the Ear upon which it is plac'd, and consequently hindering the Impression of the Air upon these Parts, as the Eyelid being shut, hinders it from coming to the Eye.

We have already said, there are three Ramifications of three different Pairs of Nerves, which are distributed upon the Cartilaginous Part of the auditory Passage, which occasion that extreme Sensibility, which is found in this Part, by which the Animal is advertis'd of the least extraneous Body, which might insinuate it self into the auditory Passage.

This will suffice for what concerns the External Ear; the *Membrana Tympani* is the first Part which presents it self to the View in the internal Ear, and although it may be said not to be absolutely necessary for the Preservation of the other Organs of Hearing, since some that are deaf can hold of the Handle of an Instrument by their Teeth, can hear the Sound of it is nevertheless of so great a Consequence,

quence, that if we lacerate or pierce through in any Animal, they may hear tolerably well for some time; but the Hearing will grow insensibly weaker, and they will entirely lose it at last.

*It is extended
and relax'd
by the Mus-
cles of the
Malleus.*

This Membrane is extended and relaxed by the little Muscles belonging to the *Malleus*, which is join'd to the back Part of this Membrane: the external Muscle relaxes it, and forms it into a plain Surface; the internal Muscle which is situated upon the Surface of the *Ossiculum*, draws it inwards, and consequently extends it more than it is in its natural State. Now the Tension of the *Membrana Tympani* is form'd in such a manner, that both the Muscles act together whereas in its relax'd State, the Action is perform'd by the external Muscle alone. The Reason of this is, because the Insertion of the external Muscle, being opposite to it, is fix'd near the Head of the *Malleus*; whereas the other Muscle is inserted on the other Side, a little lower towards the Handle. The Force of the Contraction of the internal Muscle, increas'd by that of the External, so that these two Muscles draw the Extremity of the Handle of the *Malleus* inwards, which the Tension of the *Membrana Tympani*

pani is chiefly attributed. The Figure explains this more clearly. See Plate VI. Fig. V.

It is certain then that these little Muscles act, and it is also evident at least of the two first, that one extends and the other relaxes the *Membrana Tympani*; but the Difficulty is to know on what Occasions they act, and what it is that causes them to place this Membrane in those different Positions in which it must necessarily be, to receive the different Impressions of Noise, and of different Sounds.

Is it the Will that makes them act? *The Will is* There is not the least Reason to suspect *not the Cause* it: For in short, a Noise most commonly *of these Mus-* surprises us without our being appriz'd of *cles acting;* it. And it is my Opinion that the Objects themselves are the sole Motives, which cause these Muscles to extend or relax the *Membrana Tympani* on different Occasions, according to their different Impressions.

Therefore it is my Sentiment, that the *But the differ-* Membrane of the *Tympanum* must be *rent Disposi-* variously dispos'd for the receiving the *tions of the* various Undulations of the Air, and that *Objects.* in Reality it wou'd be impossible for it to transmit them such as they are, if it was not in some measure fitted to their Character; and if on different Occasions, it did

E

not

not form it self, if I may use the Expression into proper Tensions to represent the various Tones of the sonorous Bodies. We know that upon placing two Lutes upon one Table; if upon playing upon one String, we wou'd make a String of the other Lute move, we must of Necessity place it in Unison with that which we play upon; either in the Octave, or some other Accords; as the double Octave, or the Fifth or the Fourth; otherwise it will indeed vibrate, but the Vibrations will be very weak, and never audible.

And according to the different Occasions which concur

The Membrana Tympani is more or less relax'd.

According to the Diversity of Sounds.

This being allow'd, we may with a great deal of Probability advance, that since the Diversity of Noises and Sounds depend upon the different Nature and various Pulsations of the sonorous Bodies, that for example, the acute Tone proceeds from a Pulsation on a Body, whose Particles are dispos'd in such a manner, that they are incapable of any but very quick Vibrations, which they immediately communicate to the Air; that on the contrary the Grave Tone is produc'd by a Pulsation on a Body so order'd, that it is capable of none but very slow Vibrations: We may, I say, assert that the Membrane of the *Tympanum* conforms in some manner to the different Dispositions

sitions of the sonorous Bodies in its different States of Tension and Relaxation; and, if we may be allow'd the Expression, puts on their Character; as for example, it is extended for acute Tones, because in this State of Tension it is more capable of quick Vibrations, but on the contrary, it is relax'd for Grave Tones, because it being thus relax'd, it is better dispos'd for slower Undulations; and lastly, it rises and falls in a thousand different Ways, as the different Ideas of the different Noises and Sounds. I confess it is hard to conceive how this is perform'd; they are mechanical Motions which are imperceptible, the Nature and Causes of which are difficult to explain.

Which it does in putting on their Characters.

By mechanical Motions, which are difficult to explain.

The *Membrana Tympani* therefore receives the various Undulations of the Air, and communicates them afterwards to the other Parts of the internal Ear. It is a dry, thin and transparent Membrane, this Structure renders it fit for that Use, and if these Qualities happen to be impair'd, we need not be amaz'd if a Thickness of Hearing thereupon ensues.

The Agitation of the Membrana Tympani is communicated to the other Organs of Hearing.

There is room to believe that the Air, which is found in the *Tympanum*, being agitated by the Pulsations on the *Membrana Tympani*, contributes partly at least to communicate them to the immediate

Not so much by the help of the Air which is inclos'd in the Cavities of the Ear,

Organ. But nevertheless there is no apparent Reason to imagine that this small Quantity of agitated Air, is capable of shaking the *Os Petrosum*, or rather the Labyrinth which is contain'd in the *Os Petrosum* strong enough: So that we may

As by the Assistance of the little Bones.

Which shake the Labyrinth, and the Air which is inclos'd in it.

assert with great probability, that the Pulsations on the *Membrana Tympani* are also communicated to the *Malleus*; which the *Malleus* communicates to the *Incus*, the *Incus* to the *Stapes*, whose Vibration shakes the *Os Petrosum* and the Labyrinth, in the same manner as the Air which is between two Lutes that are placed upon one Table, is incapable of communicating entirely the Undulation of a String of one of them to that of the other: but the String that is struck, must first shake the Wood of the Lute to which it is fix'd afterwards the Wood of the Lute must shake the Table, the Table the Wood of the second Lute; and lastly, the Wood of this Lute the String which is fix'd to it, and which is in Unison with that of the other. And this is so true, that if we take one of the Lutes off of the Table, and hold it up in the Air, the Experiment won't succeed.

The Nature, Mechanism, and Articulation of these three little Bones seem to favour this Opinion; they are dry, thin

and hard, and consequently very capable of being agitated. The *Malleus* through the whole length of its Handle is fix'd to the *Membrana Tympani*, so that it is easy to imagine that this Membrane can't be agitated without communicating its Agitations to the *Malleus*, and so successively to the other little Bones, since they are articulated together, and their Articulation being without Cartilages, may easily facilitate this Communication of the Vibrations from one to the other.

It is very difficult to determine the Use of the Muscle of the *Stapes*; we may suppose that in drawing the *Basis* of the *Stapes* a little outwards, which is immediately situated upon the *Fenestra Ovalis*, it extends the little Membrane with which the upper part of its *Basis* is cover'd; and therefore as it extends it more or less, it renders it also more or less dispos'd to receive the Vibrations of the *Membrana Tympani*, and to communicate them to the *Vestibulum*, and to the Labyrinth. We may also add, that in drawing out the *Stapes*, which is also pretty flexible, it extends it in some measure, and keeps it in a firmer State, and consequently disposes it in a better way, to receive the Vibrations of the *Malleus* and *Incus*.

The Muscle of the Stapes, serves to extend the Membrane which is fix'd to its Basis.

And to extend the Stapes itself.

The Passage of the Processus Mammillaris affords a Passage to the Air, when it is over-press'd in the Tympanum.

I have already said, that at the Sides of the *Tympanum* there are two Passages, one of which terminates at the Palate, and the other proceeds into the *Cavernulae* of the *Processus Mammillaris*. It seems to be very likely, that when the *Membrana Tympani* is drawn inwards, the Air which is inclos'd in the *Tympanum* retires into these two Passages, and that it returns into the *Tympanum*, when the *Membrana Tympani* is relax'd, otherwise the Motion of this Membrane wou'd be very much retarded by the Elasticity and Resistance of the Air, if it had no way to pass out of it. And there is the same Reason to believe, that the return of this Air into the *Tympanum*, favours the Reduction of the *Membrana Tympani* into its natural Disposition.

The Aqueduct serves to bring the Air from without to it.

The Passage which goes from the Palate to the Ear, furnishes the Air which is necessary for the continual Renewing of that of the *Tympanum*: And as the too great Coldness of the external Air might be prejudicial to the internal Parts of the Ear, therefore this same Air as it ascends up the Length of the Cavity of the *Nostrils*, and during its whole Course as far as the *Tympanum*, receives such Modulations as are necessary and suited to the Structure of the Parts thro' which it is to pass, yet with-

And to renew that which is in the Tympanum.

without losing the strength of Elasticity which makes it capable of performing the Uses for which it was design'd; and therefore the Air which returns from the Lungs, and which is mix'd with impure Vapours, does not so easily enter into this Canal, the Orifice of which is so plac'd at the *Fundus* of the Mouth, that it oftener receives the Air from the Nostrils, than that which returns from the Lungs.

Almost every body believes that by the assistance of this Canal, some deaf People can hear the sound of string'd Instruments, and that their Deafness proceeding from the *Membrana Tympani* its not being able to discharge its Offices, no body shou'd be surpriz'd, if the Vibrations of the external Air being communicated to the *Tympanum*, that these sort of People are capable of hearing the Sound of an Instrument. Nevertheless, to make it appear that the Vibrations of the Air which come into the *Tympanum* by the help of this Canal, are not sufficient to make these deaf People hear the Sound of an Instrument, we must here take notice that they are oblig'd to hold the Handle with their Teeth, otherwise they could not hear it at all, or at least not so perfect; now it is easy to imagine

And not to supply the Office of the Membrana Tympani.

that the Teeth being agitated, this Agitation is communicated to the maxillary Bone, from thence to the *Os Temporale*, then to the little Bones of the Ear, and what yet more strengthens my Opinion, is, what I have said concerning the Use which I have ascrib'd to these last mention'd Bones: for even those who are not Deaf, hear better and more strongly the Sound of an Instrument, when they hold its Handle with their Teeth, and stop their Ears. Besides this, there are some deaf People, who hear much better when we talk with them over their Heads: and in these we have Reason to believe that the whole *Cranium* being shook, the *Os Petrosum* and all the other Bones are also shaken successively.

The Fenestra Ovalis communicates the Vibrations of the Air to the Labyrinth. I have already remark'd that the *Fenestra Ovalis* is exactly shut up by the Basis of the *Stapes*: This little dry and fine Bone, whose Basis is very slender, and one of whose Sides is cover'd with a Membrane, having receiv'd the Vibrations from the two other Bones, and from the Air contain'd in the *Tympanum*, may very easily communicate them to the *Vestibulum* and to the Air contain'd therein, and afterwards to the *Cochlea*, and to the three Semi-circular Canals.

Besides

Besides this *Fenestra Ovalis*, there is another which is call'd *Rotunda*, which is shut up by a Membrane pretty much like the *Membrana Tympani*; and we imagine that it receives the Vibrations from the Air contain'd in the *Tympanum*, and that it communicates them to that which is inclos'd in the *Scala Inferior* of the *Cochlea*; which being very much confin'd and pent up in this Place, where there is no Passage for its passing out, it is very capable of causing a strong Vibration in the *Lamina Spiralis*; and after this Manner, the Vibrations of the Air at last reach the immediate Organ of Hearing, which remains to be treated on.

This Organ is comprehended under the Name of the Labyrinth, which being inclos'd in the *Os Petrosum*, consists of two principal Parts, viz. the *Cochlea* and the *Vestibulum*, with its three Semi-circular Canals.

As for the *Cochlea*, no body need doubt of its forming Part of the immediate Organ. Its Composition is a convincing Proof; for first the *Lamina Spiralis*, which is the principal Part of it, is hard, dry, slender and brittle, which are the Conditions requisite to render Bodies capable of being vibrated. Secondly, This

The Fenestra Rotunda communicates them to the Scala Inferior of the Cochlea.

The immediate Organ consists of two Parts which compose the Labyrinth.

The first of which is the Cochlea. The Lamina Spiralis is easily vibrated. 1. Because of its Substance.

2. Because it *Lamina* does not lie upon the Inside of the Semi-oval Spiral Canal, but is extended, joining on one Side to the Axis; on the other, to a very fine Membrane which is connected to the Surface of this Canal: so that this Situation of the *Lamina Spiralis*, is very favourable to the Disposition it must have to be easily vibrated. Thirdly, The *Lamina Spiralis* divides the whole Passage of the Spiral Canal as it were into Ranges of Stairs or *Scalae* in the *Cochlea*, built upon the same *Axis*, the upper one of which has no Communication with the lower. The *Fenestra Rotunda* opens into the lower one, which has no Communication with the *Scala Superior* of this Canal, which I have before taken notice of, nor with the *Vestibulum*: So that the Air which is inclos'd in the *Scala Inferior*, is agitated as much by the Vibrations of the *Fenestra Rotunda*, as by those of the Air in the *Scala Superior* of the Semi-oval Canal, which is also as much shaken by the Impulses of the Air contain'd in the *Vestibulum* with which it has a Communication, as by those of the Air inclos'd in the *Scala Inferior* of this Canal; the *Lamina Spiralis* being agitated on both sides, its Vibrations

3dly. Because in dividing the Semi-Oval Canal into two *Scalae*, it receives Pulsations from the upper and the under one.

brations must be more lively and strong. Fourthly, The Spiral Figure of this *Lamina* is moreover a very powerful Argument to sustain what I assert; for as it makes two Turns and a half round the *Axis*, it receives the different Vibrations of the Air in many Places, and this Mechanism is also observ'd in the Tongue and in the Nose, &c. Fifthly, A considerable Branch of the *Portio Mollis* of the auditory Nerve, after it is come to the Basis of the *Cocblea*, divides it self into many small Ramifications, which passing through all the little Perforations in the *Axis*, are distributed and lost in the different Windings of this spiral *Lamina*. In short, this *Lamina* is not only capable of receiving the Vibrations of the Air, but its Structure makes it appear credible, that it is sufficient to answer to all their different Characters: For it being larger at the beginning of its first Convolution than it is at the Extremity of the last, where it finishes as in a point, and its other Parts diminishing in proportion in Bulk, we may suppose that the larger Parts may be vibrated without the others participating in that Vibration; and therefore they are capable of receiving none but the slower Undulations, which consequently answer

4thly. Because its spiral Figure is the cause of its being vibrated in many Places.

5thly. This *Lamina* receives all the different Vibrations of the Air, because of its unequal Figure.

to graveTones : And that, on the contrary, its narrower Parts being agitated, their Undulations are quicker, and consequently answer to acute Tones. In the same manner that the larger Parts of a steel Spring form the slowest Undulations, and answer to graveTones : And so its narrower Parts form quicker and more frequent Vibrations, and consequently answer to acute Tones. So that in short the Spirits of the Nerve, which expanded over its Substance, receive different Impressions which represent in the Brain the different Appearances of Tones according to the different Vibrations of the *Lamina Spiralis*.

The second Part of the immediate Organs comprehends the Vestibulum and the three Semi-circular Canals.

As for the *Vestibulum* and the three Semi-circular Canals, although some say that they are only subservient in increasing the Impressions of the Vibrations of the Air, others affirm that they deaden them ; it is my Opinion that they form Part of the immediate Organ, for the following Reasons.

In the first place, all Birds have but three Passages which are curv'd in a Semi-circle, and a fourth which is strait and clos'd up at one End, but which opens with the others in a Cavity common to them all, and which supplies the Place of a *Vestibulum*. These three Canals
are

are also found in Fishes; there is no *Cochlea* in neither of them, nevertheless they hear: it is therefore certain, that these Semi-circular Canals are the immediate Organ of Hearing in Birds and in Fishes. Why then should they not have the same Use in Man, since their Structure is the same in Man as in these Animals? From hence at least it necessarily follows, that these Semi-circular Canals form part of the immediate Organ in Man, and that therefore this Organ is compos'd of two essential Parts.

The Cochlea is not to be found either in Birds or in Fishes.

The Semi-circular Canals alone perform the Office of the immediate Organ in these Animals.

Secondly, No body disputes the Communication of the Impression of Sounds to the Brain being perform'd by the *Portio Mollis*: now this *Portio Mollis* has two Ramifications which enter the Cavity of the *Vestibulum*, and which unfold themselves and are extended into Filaments and Membranes, which line these Semi-circular Canals internally; from hence I conclude, that this Part of the Labyrinth forms also part of the immediate Organ.

There are Nerves and Membranes which are the cause of these Semi-circular Canals, forming part of the immediate Organ.

Thirdly, The Structure of the *Vestibulum*, and of these Semi-circular Canals is such, that we may very reasonably imagine that the Impression of Sounds is increas'd and strengthen'd in these convoluted Paths, and that it must consequently

Their Windings serve to augment the Force of the Air, by the Refractions which they cause.

ly

ly become more capable of causing a Vibration on the Nerves which are distributed there.

But as I have already said, that the *Lamina Spiralis* does not barely receive the Vibrations of the Air, and that all its Parts are not indifferently capable of answering to the same Tones; I also assert as much of these three Semi-circular Canals. Every one of these Canals is in the form of two Trumpets, which have their narrower Ends plac'd one within the other; that is to say, that the two Orifices of these Canals are larger in the Cavity of the *Vestibulum*, like the broad Ends of two Trumpets; and that the Middle of these Canals, which I look upon as the Place where the two Trumpets meet is narrower in Proportion: There are two of these Canals which have an Orifice into the *Vestibulum* common to them both, which together form a very large End in comparison to the others. Now it is demonstrated by Experience, that the greater Circles of the broad Ends of Trumpets may be agitated without the lesser being sensibly affected: That the Vibrations of the great Circles are slower and more distinct, and that on these Occasions the Sound of the Trumpet is grave;

grave; whereas when the small Circles of the same Ends of the Trumpets are agitated without the great being sensible of it, the Sound of the Trumpet is then acute, because the Vibrations of these small Circles are quicker and more frequent. We may assert the same of the Semi-circular Canals; their larger Parts may be agitated without the others *Because they are made like Trumpets.* being so, then the Vibrations of these same Parts will be slow; from whence will necessarily follow the Appearance of a grave Tone: & *vice versa*, when the narrower Parts are agitated without the others being so, the Appearance of an acute Tone will of necessity follow, because the Vibrations of these small Parts are quicker. From all that I have said, we may conclude that the *Cochlea* and Semi-circular Canals, are the common and immediate Organs, which not only receive the Undulations of the Air in general, but also which receive the true Idea, and the different Characters of Tones, according to the different Places of those Parts which are agitated.

It may be objected, that these Semi-circular Canals are too much continu'd, and too much fix'd to part of the *O* *Petrosum*, to be easily agitated in their different *And their Substance is very easily vibrated.*

different Parts, and in so many different ways. But besides that no body can make any considerable Noise without the Os *Petrosum* being agitated, it is certain that when we prepare these Circles to shew 'em plainly by themselves, we take notice that they are surrounded with nothing but a spongy Substance. It is true, that in old Heads the bony *Laminæ* which cover these Circles before and behind, are pretty hard; but that which fills up the Space which is round these Circles, is of a more porous Nature: therefore they are always disengag'd enough, and very capable of being agitated, and of Reverberating.

It is by the Communication of the auditory Nerves with those of the Voice, That the Sympathy between the Voice and the Hearing is caus'd.

By the Communication of the *Portio Dura* of the auditory Nerve, with the Ramifications of the fifth Pair which are distributed to the Parts, which serve to form and to modulate the Voice, the Communication which there is between the Hearing and Speech is commonly explain'd. Some say that the Vibration of the Nerves of the Ear, being communicated to the Nerves of the fifth Pair, causes the Spirits which flow from the Brain into these Nerves, which proceed to the Parts which form the Voice, to dispose the Muscles in such a manner, that

that answering the Impression which the Voice hath made in the Brain, they are put in a Method of forming a Voice quite like it. And this Reason is alledg'd for Men and Birds exciting one another to sing, and for those Men who are born deaf, being also consequently dumb.

It is also said, that it is by the Communication of the second vertebral Pair with the external Ear, that at the least Noise it is customary to turn one's Head: And all the Body is dispos'd to make different Motions, according as the Causes of the Noise are beneficial or hurtful. And as these Nerves communicate with those of the Heart and the Lungs, it is from hence that we feel the same Alterations in the Pulse and in Respiration, according to the Difference of the Noises. But every one does not agree in the Effects of all these Communications.

And by the Communication of the second vertebral Pair.

That the Affinity that there is between the Tones of Hearing, and the Motions of the Body is produced.

And that of the Pulse.

End of the Second Part.

O F



OF THE
O R G A N
O F
H E A R I N G.

PART III.

*Containing the Disorders of the
Organ of Hearing.*

*The Know-
ledge of the
Distempers of
the Ear, de-
pends upon
that of its
Parts which
are affected.*



AFTER having explain'd
the Structure and Uses of
the Organ of Hearing, to
finish this Subject, there re-
mains nothing else for me
to describe, but the Distempers of the
Ear.

Ear. My Design is not to trace them from their Origin, but only as they relate to the Structure of this Organ; to make it appear how advantageous the Knowledge of the Parts is to the Explication of the Diseases. I shall not confine my self to the Divisions which Authors commonly make; but shall here follow, as I have done in my Explanation of the Use of the Parts, the Order of my Description: that is to say, I shall first examine what Distempers happen to the external Parts, afterwards those which attack the *Membrana Tympani*, the *Tympanum* and *Labyrinthus*; and lastly, those which belong to the auditory Nerve. After which I shall explain the Noise or Tinckling, which is a Symptom common to the Disorders of all these Parts; and I shall not ground my Reasons but upon Observations taken from very creditable Authors, and upon those which I have had an Opportunity of making my self, when I was working upon the Ear.

The most common Symptom of the external Parts of the Ear, is Pain; it commonly infests the *Concha*, and the whole auditory Passage as far as the *Membrana Tympani*. Experience teaches us that it is accompany'd with Pricking, Erosion,

The Disorders of the auditory Passage, which cause extreme Pain and remain in this Part, proceed from

Erosion, Tension, Weight and Pulsation.

*The Solution
of Continuity.*

I shall not in this place explain the Nature of Pain in general, but shall treat of it more largely when I come to the Organ of Feeling. Now here it will be sufficient to know that Pain is caus'd by a Solution of Continuity of Particles, which when they are united, form the first Constitution of the Parts of Animal Bodies: This Solution of Continuity causes an irregular Motion in the Spirits, and in these two Things the former Reason of Pain consists.

This being allow'd, we may easily know that whatsoever can cause a Solution of Continuity in the Particles of the Membrane, which lines the auditory Passage, and excite this irregular Motion of the Spirits, is capable of producing Pain. Thus an Inflammation, extraneous Bodies in the passage, Worms, and in a word, all that can cause Pain in other Parts, may be applicable to this here. But besides this, the Ancients have maintain'd that the Pains in the Ear may happen without an Inflammation, and without any conjunct Cause; from whence they have explain'd these Pains by Intemperies alone without Matter, which

which they commonly believ'd to proceed from Excess of Cold or Heat: but as these Intemperies without Matter are imaginary, and as we may find in the Part, Things capable of producing this violent Pain, I will lay down my Sentiments of it in few Words.

I take notice, that the Wax which is a-mass'd in the Ear is bitter and viscous, *Caus'd by the Wax, which is in the Inside of the auditory Passage.* and that consequently it abounds with acrid and lixivious Salts, which are mix'd with thick and oleaginous Particles; these

Principles give it very nigh the Qualities which are attributed to the Bile, which it very much resembles. If it happens by any Means whatsoever, that these saline Juices disengage and expand themselves, and that being more exalted than usual, their Points act with more Violence; it is evident that they must cause great Disorders in the auditory Passage, because of its extreme Sensibility. Cold and Heat are most commonly the Causes of it. For Cold thickening

this Wax, and rendering it more viscous, *The external Cold increases the Acrimony of it;* causes it to obstruct and stop up the excretory Ducts of the Glands, as it may be *By the Obstruction of the excretory Ducts of the Glands.* observ'd in the other neighbouring glandular Parts, in which this Action of the Air causes the like Obstructions: from whence

Which renders the saline Juices more pungent.

By Heat, which loosens and dissolves these saline Juices.

Or by the sharp saline and serous Humours, which sometimes come out of the Glands of the Ear.

whence it follows, that the saline Juices which were in motion, and in a Disposition to pass out, being obstructed in the Glands, puff up and swell them; and becoming more acrimonious by their being detain'd, prick upon the Extremities of the Nerves, with which the auditory Passage is stor'd; and are the Cause of a very great Disorder in the Spirits, and consequently of that great Pain of the Ear. On the other hand, the external Heat loosens and dissolves the saline Juices of this Wax, and produces by this Means the same Effect. The same Thing is observable in the Pains, which are caus'd by the Bile in the alimentary Parts, by the excessive Degrees of Heat or Cold.

But the Ear-Wax is not the only Cause of these acute and violent Pains; it very often happens that those sharp, saline, serous Humours, which are evacuated by the Glands of the Ear, cause Pain in the auditory Passage, which is apparent in the Suppurations of this Part: For as these serous Humours which are emitted, are sometimes Acrimonious or Saline, they stimulate the Membrane of the Passage, and excite an uneasy Sensation, which is what we call Pain.

As

As for the different Sensations of Pain, *The different Solutions of Continuity, cause the different Sensations.* I believe they may be accounted for in this Manner: When the saline Particles of Wax, or even the other Humours contain'd in the Substance of the Glands, are become pointed and hard, and by being more strongly agitated than usual, they strike violently upon the nervous Filaments of this Passage, and produce a pungent Pain, which happens in all Inflammations, and especially in Persons of a dry and bilious Habit of Body, whose Humours are fill'd with those acrid and saline Juices: and in People of a melancholic Habit, in whom the serous Part of the Blood is always sharp or salt; when these Salts become very acrimonious or very corrosive, they cause Pain accompany'd with Erosion, which is chiefly to be taken notice of in Ulcers of this Part. When the Substance of the Wax which is still contain'd in the Glands, is fermented alone or with other Fluids, it extends or dilates the Particles of the Membrane, and causes a Sensation of Tension. When the Glands are swell'd with the abundance of the Fluid with which they are fill'd, they leave a Sensation of Weight: As for that sort of Pain which is accompanied with Pulsation, I believe

Of pungent Pain.

Of Erosion.

Of Tension.

Of Weight.

Of Pulsation.

believe it never happens to the auditory Passage, but when it is inflam'd.

*This Pain is
very violent,
because*

There is nothing so surprizing as the Violence of this Pain; it is hardly ever without an acute Fever, which is attended with Wakings, Deliriousness, Convulsions, and Swoonings; Symptoms which are often the Cause of Death, as may be seen in Observations made by many Authors: For the better understanding the Violence of this Pain, we must observe, First, That the Membrane, which lines the auditory Passage, is fine and nervous, and compos'd of the same Texture as the nervous Membrane of the Stomach and Intestines, excepting its not being indu'd with those Villi, to preserve it from the Acrimony of the Humours.

*The Membrane of the
Passage is
compos'd of a
fine and nervous
Texture.*

*And receives
a great Number
of Nerves.*

2. It is cover'd with an infinite Number of Nerves, which it receives from the fifth Pair, from the *Portio Dura* of the auditory Nerve, and from the second vertebral Pair, as it has been describ'd in the first Part of this Treatise; and we may assert, that there is no Membrane in the whole Body, which has more Nerves in proportion than this has. It is certain that those Membranes which are fix'd close upon the Bones, have a more exquisite Sensation than the others, which

*This fix'd
close upon the
Bone.*

may possibly proceed from their being
more firm and more extended, and that
being connected to the Bones by all their
small Vessels which they send off to them ;
it is impossible that these Vessels can be
stimulated, without all their small Rami-
fications being agitated at the same time,
and for this Reason the *Periosteum* and *Pe-
ricranium* have so exquisite a Sensation :
and in the same manner we may imagine
that the acutest Pains of the Head pro-
ceed from the Adherence of the *Dura
Mater* to the Top of the *Cranium*, as
it has been observ'd. This is easily ap-
plicable to the Membrane of the auditory
Passage, for this Passage is partly bony
and partly cartilaginous, and the Mem-
brane is extended upon the Cartilage,
though not quite so much as it is upon
the Bone. Now it is remarkable that
those Pains which infest the Bottom of
the Ear, which is the bony Canal, are
always the most violent. 4. The Con-
nexion of this Membrane with the neigh-
bouring Parts, may greatly contribute to
the Acuteness of the Pain; for this Mem-
brane is extended as far as the *Membrana
Tympani*, which communicates with the
Membranes which line the *Tympanum*,
and with those of the Labyrinth; and

*And connected
with other ve-
ry sensible
Membranes.*

F

by

by their means with the *Dura Mater*. After, need we be astonish'd if the Pains in the Passage are so sharp and violent?

Although the greatest Part of the Symptoms which accompany the Pain of the Passage, may be met with in the Pains of other Parts, nevertheless as these Symptoms are, more frequent and more violent in this Part, I judg'd it necessary to explain them.

When this Pain is caus'd by an Inflammation, there is no Difficulty in giving a Reason for the Fever, and the other Symptoms which commonly attend it. But as I am convinc'd the Acuteness of the Pain alone may cause all these Symptoms without either Inflammation or Tumour, I shall apply myself chiefly to this last Case.

*And this often
causes an a-
cute Fever,*

*By the Agita-
tion of the Spi-
rits.*

I begin with the violent Fever, which almost always accompanies the Pain of the Ear; and I take this to proceed from the Spirits being agitated by the Violence of the Pain, which encrease the Motion of the Heart and of the Arteries which is the Cause of the Quickness of the Pulse and of the Increase of Heat as is visible in some Passions, and particularly in that of Anger. But this Augmentation of the Motion of the Heart

and

and Blood, does not produce a real Fever without it disorders the Principles of the Blood. Now it is easy to conceive, that by these strong Contractions of the Heart, the Parts of the Blood being more exactly broken and divided, an Exaltation of its most active Particles is caus'd, and its oily Part is more perfectly dissolv'd, whose swift and rapid Motion is the Cause of Heat in the Fever. Moreover, the acrimonious and corrosive Juices of the Wax, and of the serous Humours which are amass'd in the Ear, may re-enter and mix with the Mass of the Blood, and there cause an extraordinary Fermentation, in which the Essence of a Fever consists. We shall easily comprehend this sort of Fever, if we consider that in Colds the Fever springs from the Mixture of the sharp Juices, which separating from the Mass which is the Cause of the Continuance of the Cold, mix with the Blood.

*And by the
Fermentation
of the Blood.*

The Watchfulness, or Inability of Sleep, depends upon the extraordinary Agitation of the Spirits; which finding themselves continually irritated by the Violence of the Pain, flow continually into the Parts, and maintain them in their Functions.

Watchfulness.

The Delirium: The Deliriousness differs in nothing from the Watchfulness, but that in this the Spirits moving irregularly in the Brain, they touch at the same time many Traces of the Memory and Imagination, which cause a Confusion in the *Ideas*, that these same Spirits represent to the Soul.

Convulsions, The Convulsions are easily explain'd in this *Hypothesis*; for the involuntary Contractions of the Muscles being caus'd by the irregular Motion of the Spirits, it is sufficient that the saline Juices stimulate the Nerves, which are interspersed in the Membrane of this Passage, to cause that Irritation to be communicated to all the Spirits, by the Communication of the Nerves and Membranes, and afterwards to cause Convulsions in the Muscles. Besides, it may happen that these sharp Juices re-enter the Blood, and being carried to the Brain, cause Irritations in that Origin of the Nerves.

And Swooning. To give a Reason for the Swooning, we must consider, that the Spirits flowing swiftly, and in great abundance into the Muscular Fibres, which contract and shut up the Orifices of the Heart, they stop the Motion of the Blood; and when this Contraction ceases, and the
Blood

Blood enters afresh into the Heart, the Pulse and the Heat are renew'd: The Oppression of the Heart and Weight in the Breast, which are felt in this State, are pretty sure Indications of the Swooning proceeding from the Cause which we have just describ'd; and this Oppression of the Heart may continue so long, as sometimes to be the Occasion of Death.

For an Example of a great Pain in the Ear, accompanied with violent Symptoms, I shall content myself with only giving you the fourth Observation of the first Century from *Fabricius Hildanus*, because it includes all the principal Symptoms. A young Girl twelve Years old, having by chance let a Glass-Ball enter into the Hole of her left Ear, which could by no means be extracted, was seized with acute Pains, which were communicated to the same Side of the Head: These Pains, after a long space of Time, did produce a Numbness in the Arm and Hand, afterwards in the Thigh and Leg, and at last in all the left Side. This Numbness was accompanied with very great Pains, which encreas'd in the Night, and in cold and wet Weather with an Irregularity in her *Menses*, with Epileptic

*History upon
this Subject.*

Fits, and with an Emaciation of her left Arm. *Fabricius Hildanus* eight Years after extracted the Glass-Ball, and then all the Symptoms ceased, to which all the other Remedies which were us'd for so long a time, could not give the least Ease.

*Remarks upon
this History.*

Many Remarks might be made upon this Observation; but as I have explain'd the greatest part of its Symptoms, I shall apply myself only to some which are particular in this Case. The Pains and Convulsions seiz'd on all her left Side to the end of her Foot. *Hildanus* has explain'd this *Phænomenon*, by saying that the *Portio Dura* is distributed along the Arm, and to the Thigh: But as this Distribution is imaginary, I shall endeavour to give a Reason more suitable to the Parts. I therefore think that the Irritations and irregular Motion of the Spirits, had pass'd into all the Nerves of the *Medulla* on this side, by the Communication of the second Vertebral Pair: This is what would not have happen'd, if the Irritation had been communicated to the Brain; for then there is Reason to imagine that this Girl would have suffer'd Pains and Convulsions in all Parts of her Body: From whence I suppose the left Side of

the

the *Medulla* to be only affected: it is easy to conceive how this Indisposition should pass into the Arm and into the Leg, since we know that all the vertebral Nerves of the same Side communicate with one another by transverse Ramifications, after they have passed out of the *Foramina* of the *Vertebræ*.

All the Symptoms increas'd in the Night and in wet weather, because the Humidity of the Air puffing up the Glands and the Membranes of the Passage, made it more closely embrace the Glass-Ball, which increas'd the Irritations.

The Numbness in all likelihood proceeded from the irritated Spirits opening and dilating the Orifices of the Nerves, in such a manner that they not only afforded a Passage to the Spirits, but also to much grosser Substances; which being forc'd into their Tubes, caus'd a sort of an Obstruction in them, capable of hindering the Motion of the Spirits, which is sufficient to cause a Numbness. These Substances becoming more acrimonious by their Detention, increas'd the Pains and Convulsions; which being found more violent in the Arm, its Nerves imbibed such a Quantity of these extraneous Sub-

stances, that the Motion of the Spirits was thereby interrupted, which was the Reason of the Arms becoming emaciated and wither'd, as it happens in Palsies.

After the Glass-Ball was extracted, the Irritations which it caus'd ceas'd, and consequently the Pains and Convulsions: The Spirits recovering their common Course, insensibly dissipated all the extraneous Bodies, which caus'd the Arm to regain its Motion and pristine Vigour.

*Remedies to
be us'd for the
Pain caus'd*

I now come to the Means which are to be us'd in the Cure of this Distemper. They must be different, because of the Diversity of the Causes which produce it. As for the Pain, that which is produc'd by Cold, is sometimes cur'd by taking away the external Cause; that is to say, by keeping it from the Cold and the Wind, and by applying upon the Ear, every thing that way warm it, as thick Wool, or hot Bread, which may also be steep'd in Spirits of Wine; but the Pain seldom yields to these first Remedies, and then we must be oblig'd to proceed to the general Remedies: Bleeding is necessary to him, der a Collection of those Bodies, which the Cold has detain'd; and as for Purging, it is not to be order'd till the violence of the Pain is diminish'd. Du-
ring

ring their Use, Fomentations are very successfully employ'd, or Injections compos'd of the Juices or of the Decoctions of *Baum*, *Hyssop*, *Calamint*, *Origany*, *Marjoram*, in which we may mix some Drops of *Bullocks Gall*, or rather some Drops of Oil of bitter *Almonds*, or *Camomile*, *Cloves*, *Aniseeds*, &c. Authors very much recommend the stopping the Ear with Cotton perfum'd with Musk; there is no Difficulty in explaining the Effect of these Remedies, they are all endued with a very penetrating volatile Salt, which warming these Parts, open the Pores, and the Ducts of the Glands, and cause the Substance to flow, which was before retain'd by the Cold.

The Pain which proceeds from Heat, *For the Pain* is most commonly cur'd by general Re-*proceeding* medies, especially by Bleeding, which *from Heat.* is absolutely necessary to hinder a Fluxion and an Inflammation, which might happen to the Part. During the Use of these Remedies, we may with great success make use of Injections compos'd of Milk, that of a Woman is better than any other, when it is mix'd and beat up with the White of an Egg; besides this, they make their Injections of some cooling and emollient Decoction, in which they

drop some Oil of sweet Almonds ; the Yolk of an Egg is very much commend-
ed by *Devigo*. We may also apply some
emollient and anodyne *Cataplasm* upon
the Ear; and when the Pains are extreme-
ly violent, we must have recourse to
Narcotics, which may be mix'd with the
topical Remedies, and likewise be given
internally. All these Remedies are so
well known, and so much us'd, that I
shall not stop here to give you an Ac-
count of their Operations.

*For the Pain
caus'd by se-
rous Hu-
mours.*

When the Pain is caus'd by sharp and
salt serous Humours, the Water of *Car-
dus Benedictus*, or blessed Thistle, is us'd,
in which, Woodlice, Earthworms, and
Ants Eggs, &c. are boil'd: We may add,
a few Drops of Oil of Box. As the Medi-
cines abound with an *alkalious* volatile Salt,
they destroy the Acidity of the serous
Humours, which were the Cause of the
Pain.

*The Causes
which pro-
duce the In-
flammation in
the auditory
Passage are,*

The second Distemper that I shall take
notice of incident to the auditory Passage
is Inflammation with Abscess, and Ul-
cer, which commonly succeed it. An In-
flammation proceeds from Wounds and
Contusions of this Part, and may also be
the Sequel of certain Fevers, as of the
Pleurisy, *Quincy*, and of many others
of

of the same nature. It very often happens that an Inflammation may be produc'd in the auditory Passage, in two different Ways. The first is from an Obstruction of the Glands, which pressing upon the Vessels, stop the Blood, and by that means are lacerated by it. The second is from the Acrimony of the Wax, which may lacerate these same Vessels, and by that means cause an Extravasation of the Blood. However it be, the Inflammation and Abscess which succeed it, have nothing particular in them, but the violent Pain which I have already describ'd.

The Ulcers of this Part are form'd in the same manner as Ulcers of other Parts, either from a Rupture of an Abscess, or by the Acrimony of some Fluid: I take notice that they commonly send forth a very large Quantity of Matter, and that they are very difficult to cure, especially those which are in the bony Part of the Passage. The Quantity of Matter proceeds not only from the Blood which is suppurated, but also from the Glands, which being always irritated by the Pus, spue forth a very large Quantity of Fluids through their excretory Ducts; and the Difficulty which is found in curing these

Ulcers, proceeds from their being constantly moisten'd by the Fluid, which comes from these Glands, so that they cannot be dry'd up : besides, the Matter which proceeds from these Glands, being sharp and saline, hinders the *Reunion* and the *Cicatrix*; the same thing happens in Ulcers of the Nose, of the salivary Ducts, &c. Ulcers in the bony Passage are more difficult to cure than those of the cartilaginous Passage, because the bony Passage runs down towards the *Membrana Tympani*, and makes a considerable Descent in the Place where it grows flat, which is the Cause that the *Pus* cannot pass out of it but with difficulty ; whereas the Descent of the cartilaginous Passage being towards the *Concha*, the *Pus* and other Humours are immediately evacuated, and don't remain here as they do in the other Passage.

We sometimes meet with Worms in the Passage.

It sometimes happens in old Ulcers of the Ear, that Worms of different Figure and Size come out with the *Pus*, as may be seen in the Observations made by *Forestus Schenkiius*, and in the *German Journals*. I shall not stay here to examine whether these Worms are produced by the Corruption of Humours, or whether the Heat only of these Ulcers hatch
the

the Eggs, which thousands of Insects that fly in the Air may possibly leave in this place ; I shall have an Opportunity of treating of it upon some other Occasion.

Besides the *Pus* which passes out of the Ears in Ulcers, it is remark'd that in almost all Children the Ears emit a great Quantity of Humidity, and that this Evacuation is of very great use to 'em ; wherefore we take care not to stop it, or else the Children wou'd fall into convulsive and epileptic Fits, which has made it been believ'd that this Fluid came from the Brain as well as those clear and fetid Humours which some People emit at their Ears: Nevertheless, it is certain that there is no visible Ways by which any thing can come from the Brain into this Part: for there is but one *Foramen* in the *Os Petrosum*, which forms an impervious Passage at its Extremity on the Side of the Ear, and which is exactly stop'd up by the auditory Nerves; therefore it is scarcely credible, that any thing can come by that Way. But if even these watry Humours and Blood cou'd erode the Bottom of this *Foramen*, and so procure a Passage through this Place, these cou'd enter no where but into the *Vestibulum* and *Cochlea*, and must necessarily

The Cause of the Suppuration, and the Flux of Blood,

Which apparently does not come from the Brain.

necessarily erode the Membrane which closes up the *Fenestra Rotunda*, the Basis of the *Stapes*, and the Membrane that covers it, to pass into the *Tympanum*; at last, when they are come into the *Tympanum*, they certainly must rather fall into the Mouth through the Aqueduct, than lacerate the *Membrana Tympani*, to pass through the auditory Passage. I do find this Difficulty in explaining these *Phaenomena*; if Children emit a great Quantity of watry Humours through their Ears, it must be attributed to the Disposition of their Blood, which is aqueous; and to the Relaxation of the Glands of the Ear, which is also found in the Glands of the neighbouring Parts. And if the Suppression of this Evacuation causes them to fall into Convulsions and Epilepsies, it is easy to understand how this happens, because these Juices being stopt, may become more acrimonious by their being retian'd, and cause Irritations on the Membrane of the Passage, and may even return into the Mass of Blood, and afterwards be discharg'd on the Brain. As for those Persons who emit clear fetid Water from this Passage, we must take notice, that although the Glands of the Ear are chiefly design'd in their natural State

of HEARING.

III

State for the Secretion of the Wax, for the Uses I have before spoke of; there is no Obstacle to hinder them from serving as an Outlet, for the Evacuation of pernicious Humours, which is plainly seen in all the conglomerate Glands: and as for the Blood which in Wounds of the Head comes out of the Ears, we know that this proceeds from a Rupture of the Vessels, which are interspers'd upon the Passage. It is easy to judge, by the violent Emotion, that all the *Cranium* suffers on this Occasion, how a Rupture may be produc'd in this Part as well as in the Brain. Lastly, I shall give some Observations to prove that the Suppurations which are made in the Ear, have no manner of Communication with the Brain. A Man about sixty five years old, of a full and sanguine Habit of Body, had a very considerable Suppuration in his Ears, and especially in his Right, for five and twenty Years together, although in all other respects he enjoy'd a perfect Health. The Matter which he discharg'd was fetid and very thick; he died of an Apoplexy in four and twenty Hours after this Suppuration was stop't. I open'd the *Cranium*, and having carefully examin'd all the Parts of the Brain near
the

the *Os Petrosum*, I found them perfectly sound, and the Bone in its natural State, and I actually met with serous Humours in the Ventricles and Cavities of the Brain, which were extremely different from the Matter which came from the Ears: I have open'd the Ears of many Children, whose *Tympanum* was full of Filth, yet I never found any bad Disposition either in the Brain, or in the *Os Petrosum*.

*Cure of the
Inflammation.*

To cure the Inflammation of the auditory Passage, we must take the same Methods that are used in all Inflammations of the external Parts; that is to say, first to stop the Fluxion by Bleedings, and by those Remedies which are called *Anodyne*, which we have already mentioned in the Cure of the Pain; to which may be added, Oil of Roses, Oil of Water-Lillies, the Juice of Lettices, of Garden-Nightshade, &c. But if the Inflammation continues and tends to Suppuration, we must make use of Suppuratives; such as the Cataplasms of Crumb of Bread, and those which are made of Onions, Lilly-Root, fresh Butter, and Oil of Chamomile or Melilot.

Abscess.

Ulcer.

When the Abscess is open'd, we must make use of deterfive Injections, made with

with Barley-Water and Honey of Roses; and if there is a Necessity for stronger Remedies, we may use Decoctions of Agrimony and Birthwort, and other vulnerary Plants, in White-Wine, in which we must mix Honey of Roses or Oxymel Squills; if the Ulcer is sordid and putrid, the Tincture of Aloes made with Spirits of Wine may be us'd, and the Green Balsam of *Mets*, if it is very deep.

After this Ulcer is deterg'd, we must dry it up, and cicatrise it: for these Intentions, the Decoctions made of Plantain, Birthwort, Gall-Nuts, &c. are very much esteem'd. The *Grenada-Wine*, describ'd by *Devigo*, is an admirable Medicine. As these Medicines have no particular Quality in them, and as they are us'd in all sorts of Inflammations and Ulcers; I shall not here explain their Operation: I shall only say this, that whilst these are using, we must not neglect the general Remedies, which are a very great Help in the whole Course of these Diseases.

To destroy the Worms, we make use of *Worms*. bitter Things to put into the Ear, as the Juices of Wormwood, of little Centory, the Decoction of Coloquintida, or else a few Drops of Oil of bitter Almonds, or of Oil

Oil of Box. The *Journal des Scavans* of 1677, relates that Spirit of Wine is an infallible Remedy for Worms which are form'd in the Ears. Those of these Medicines, which are oily and thick, are excellent, because they stop up the *Bronchie* of these Insects, and suffocate them in an Instant.

*And Fluxes of
serous Hu-
mours.*

As for those Fluxes of serous Matter which we have term'd Suppurations, as they are for the most part indolent, and cannot be stop't without causing pernicious Effects, we ought not imprudently to stop 'em: In those that are painful, we must have recourse to the Remedies which have been already describ'd, when we treated of Pain.

*The third
Disease of the
auditory Pas-
sage is Ob-
struction; it
is occasion'd
by*

*Extraneous
Bodies.*

The third Disease of the auditory Passage is Obstruction; it most commonly succeeds an Inflammation, Abscesses and Ulcers, which use to swell this Part. Besides this, it may happen from many other Causes. In the first place, from extraneous Bodies, which may be introduc'd into the Passage, such as Peas, Shot, Nut, Kernels, &c. When they have been put a great way in, it is extremely difficult to extract them, because they are inclos'd by the bony Passage, which is very oblique, and proceeds downwards towards the

Membrana

Membrana Tympani; besides their being detain'd by the viscous Wax, which is collected there, the greatest Difficulty is in taking out Peas, and those other Grains which swell in the Passage, and which may even bud there, as you may see in the Examples of *Fabricius Hildanus* and *Schenkius*.

2. The most frequent Cause of Obstruction in the Passage, is the Wax ^{2. The retain'd Wax.} which is inspissated and retain'd in it: This Wax in those that don't take care to clean their Ears, is collected in a great quantity, and grows so thick by its Stay, that it entirely stops up the Passage. It may also be sometimes naturally very thick in People of a cold and pituitous Habit of Body, whose Humours are viscous, and the Cold of the external Air may very much contribute to this Effect. There is also great reason to suspect ^{Which petrifies sometimes,} that this Wax may be petrified, and cause an incurable Deafness, which seems very likely from the Conformity there is betwixt it and the Bile, which is often petrified in the *Vesica Fellis*: and this may be confirm'd by the 45th Observation of *Bartholine's Journals*, which relate, that his Wife having been a long time tormented with a Pain round her Ear,

Ear, discharg'd small Stones thro' the auditory Passage which came out with the Wax, after which the Pain was assuag'd: However, it happens this Wax is often found very thick in the form of Plaister, which exactly fills up the bony and cartilaginous Passage, which I have observ'd in more than ten or twelve Subjects, during the time I was busy upon the Ear: I have consult-ed many skilful Surgeons about it, and I may say, I have more than thirty Obser-vations which they communicated to me, which makes it evident that this sort of

*Causes a sort
of Deafness
easy to cure.*

Deafness is the most common and most curable. And that famous Surgeon of Mons, who has made so much noise in the World for curing Deafness, undertook none but this sort of Deafness: to know this, he turn'd his Patient's Ear to the Rays of the Sun, and when he discover'd any Obstruction in the Passage, he made use of a particular Instrument to clean it, and after this manner he cur'd a great Number of deaf People.

*3d. A Mem-
brane.*

There are sometimes Membranes form'd in the Inside of the Passage, which close it up exactly, and form a particular sort of Deafness. I have before, in my second Part, related that when I was examining

examining the Reason of Deafness in a Person of Merit after his Death, who had been afflicted with it a long time, I found in the right Ear, which was that with which he could not hear at all, a very thick and loose Membrane, before which there was a considerable Collection of Matter like Plaster, which was certainly the cause of his Deafness; for the *Membrana Tympani* was in its natural State, and so were the other Parts of the Ear.

4. The fungous and fleshy Excrescences, 4. Fleshy Excrescences, which sometimes succeed Ulcers of this Passage, or Excoriations which may be caused by cleaning the Ear with too sharp an Instrument, may fill it, and close it up exactly.

5. There is another Sort of Obstruction in the Passage, which is produced when all the Glands which surround it are tumified, and are fill'd with an over-great Quantity of serous Matter, in the same manner as we know the spongy Membranes of the Nose may be so much swell'd, that they almost entirely stop up the Passage of the Air: This Obstruction is always accompanied with a Relaxation of the *Membrana Tympani*, and from hence it causes a Deafness, or 5. By the Glands which surround it becoming tumified. Which is commonly accompanied with a Relaxation of the Membrana Tympani. at

at least a Thickness of Hearing, which dissipates when this over-great Quantity of serous Humours are evacuated by the Ear, or by some other way, in the same manner as all Catarrhs are cur'd.

Cure for the Obstruction caus'd by extraneous Bodies, and the Extraction of them;

In the first sort of Obstruction the whole Method of Cure consists in extraneous Bodies: to succeed in this Case, we must first consider whether they are Bodies that may grow softer, such as Peas, or whether they are hard and solid, such as Leaden-Shot, Fruit-Stones, &c. We must also observe whether these Bodies are enclos'd in the cartilaginous Passage, or whether they are intangl'd in the

Which is per-form'd by the Scoop, or the Terebra when they are enclosed in the cartilaginous Passage.

bony Passage. To extract soft Bodies which are got no farther than into the cartilaginous Passage, we must endeavour to break them, or to introduce the Scoop behind them, which may be effected in a supple pliant Part, such as the Cartilage of the Ear is, and so draw them out of the Passage. Hard Bodies also which are in the same Place may be extracted with the same Success; and this may be done either with the Scoop or the Terebra. As for those Bodies which are in the bony Passage, it is extremely difficult to extract them, as we have before taken notice of, especially when they

entirely

entirely fill up the Passage; for then it is easy to conceive that neither the Scoop nor the *Terebra* can be of any great Service. Therefore in this Case I recommend the making an Incision into the back-part and top of the Ear, which may very safely be practis'd in this Place, where there are no considerable Vessels, and where the Passage is cover'd with nothing but a glandular Skin, as may be seen in *Plate III. Fig. II.* By this means we partly avoid the Obliquity of the Passage, and make use of the *Terebra*; which is best to use in the Extraction of Shot. If a Fruit-Stone should be inclos'd in the bony Passage, as it may be taken hold of by one of its Extremities, because it is of an oval Figure, we then may make use of the Instrument call'd *Tenacula*, describ'd in the 4th Observation of the 1st Century, and which, to speak properly, is but a double Scoop in the Form of Pincers: And for this Reason the Shanks must be made of a Plate of very fine Steel to have a Spring, and must be very thin. I shall not stop here to describe all the Circumstances of these Operations, nor to say it is necessary to drop some Oil of sweet Almonds into the Ear to relax the Passage; because I suppose these

Or when they are contain'd in the bony Passage, it is effected by an Incision into the back-part of the Ear.

From whence we extract Shot with the help of the Terebra,

And Fruit-Stones with Hildanus his Scoop.

*Cure for the
Obstruction
proceeding
from the hard-
ness of the
Wax.*

these things are sufficiently known. In the second Sort of Obstruction, which is occasioned by the hardness of the Wax, we must break it, and bring it away by Injections made with warm Water, emollient Decoctions, Hydromel, Linseed-Oil mix'd with some Drops of Spirits of Wine; Oil of bitter Almonds, Oil of sweet Trefoil. Some make use of Mineral Waters, and all Galls of Animals are commonly us'd, and that with good Success. There are some that prefer warm Water to all other Liquids, and content themselves with adding to it Drops of Spirits of Wine, to render it more penetrating.

The Wax is loosen'd, and comes away sometimes in five Days, sometimes at the Expiration of the fifteenth Day; which plainly demonstrates that we ought not to grow weary of continuing Injections.

*For the Mem-
brane which
stops up the
Passage.*

In the third sort of Obstruction, where there is commonly a Collection of Wax gather'd before the Membrane, which is form'd contrary to the Course of Nature, we must clean the Passage with the foregoing Injections, and afterwards pierce the Membrane; but Surgeons ought to take care at the same time not to damage the *Membrana Tympani*.

For

For to have a true Idea of the Cure of *For Excre-*
the fourth Sort of Obstruction which is *scences.*
form'd by fungous and fleshy Excre-
scences, the reading of *Fabricius Hilda-*
nus's first Observation of the third Cen-
tury will be almost sufficient; wherein he
gives a Description of a fungous and
schirrous Excrecence, which happen'd in
the Passage after an Abscess. Before he
extirpated it, he carefully prepar'd his *Of which we*
Patient's Body; after that, he cut away *must extir-*
as much as he cou'd by the Ligature: *pate as much*
as we can by
the Ligature.
but as the Root of the Excrecence was
very deep, and as his Instruments cou'd not
possibly reach the bottom of the Passage,
he was obliged to make use of some Caus- *And consume*
ticks, which he apply'd to it by the *the Remain-*
help of a small thin piece of Wax, for *der by Caus-*
ticks.
fear of prejudicing the Passage, in which
he very happily succeeded. To make this
manner of treating these Diseases more
plain, we must take notice that if the
Fungus is large, and protrudes out of the
Passage, we may either cut it off with
the Point of the Scissors, or of the Inci-
sion Knife; or else tye all that we can
take up with a Ligature; but I think cut-
ting it is the best way, because in cutting
it we take more of it away. As we are
afterwards oblig'd to stop the Blood, we
G make

*Which must
be very care-
fully us'd, for
fear they
shou'd hurt
the Membrane
of the Pas-
sage.*

make use of a little vitriol Stone fix'd to a Quill in the form of a Crayon, so that there appears but a small Point of it out to hinder its touching any other Part but that where it is wanted, to stop the Blood by making an Eschar, which also takes away part of the *Fungus*, and to consume the rest which lies deeper in the Passage. As there must be a great deal of Caution us'd not to prejudice the Membrane by the Causticks, the most us'd of which are Powder of Savin, burnt Alum, red Precipitate mix'd up with Wax and Turpentine; I wou'd not chuse to make use of the small thin Pieces of the Wax, but I think the Causticks may be very safely apply'd in the form of an Unguent, at the end of a Tent, which may be introduc'd into the Passage, after we have plac'd a small leathern *Canula*, like the Finger of a Glove in it, into which we may easily push the Tent with the Unguent at the end of it, without being afraid of touching the Membrane which lines the Passage. Instead of Leather, we may make our *Canula* of Copper or Silver, which must be very thin, and curv'd in the same manner as the Passage is. After the Eschar is made, we must dress it up with some Drops of Oil

of Eggs, or of Oil of sweet Almonds, as much to give Ease to the Passage as to separate the Eschar: we must repeat the Application of these Medicines till the *Fungus* is consum'd, and when it is, we must make Tents and spread them at the End with *Wourtz* Brown Ointment. These Tents must be introduc'd, and push'd beyond the *Canula*, that the Ointment may reach the rest of that superfluous Flesh, which remains in the Surface of the Passage, in which the *Fungus* was, to hinder it from sprouting up afresh, and also to procure a good Digestion. After which we must make use of detensive and anodyne Medicines to incarn and cicatrise the Ulcer; always taking care to mix with them every now and then, something to stop the Regeneration of the *Fungus*. A little Vitriol dissolv'd in a sufficient Quantity of some vulnerary and petersive Decoction, to give it a little Astringency, is very fit for this purpose; we may either inject it into the Ear, or pass a little Lint dipt in this Liquor into it: the Lint is the best Method when it may be easily introduc'd, because it presses upon the Ulcer, and hinders the *Fungus* from sprouting up.

*Cure of the
Obstruction
proceeding
from the
Glands being
tumefy'd.*

In the fifth sort of Obstruction, which is occasion'd by Tumefaction of the Glands of the Passage, the same general Remedies are prescrib'd, which are us'd in all other Colds: We fumigate the Ear with the Steam of Carduus, or of Decoctions of Florentine Orris, Sweet Marjoram, Carduus, Wormwood, Baum, Calamint, Aniseeds, Fennel, &c. The Decoction of Coloquintida in Oil is very much esteem'd. *Barbette* makes use of a Decoction of Cloves in red Wine, some of which he drops into the Passage, which must afterwards be stop't up with a Clove. We find in *Platerus*, a particular Water for this purpose, which is said to be very efficacious; there is another in *Mindereus*, which has been reform'd by *Zwelfer*, in his Remarks upon the *Ausbourg Pharmacopœia*, and we have a compound Spirit of Wine in *Amynsicht*. The Juice of Sweet Marjoram press'd out alone, is very much esteem'd: And the Urine of a Hare is very much commended by itself, or mix'd with Spirits of Wine, Astringent Water, and Hungary Water; it is also a good Method to keep the Ear stop't with a little Cotton perfum'd with Musk. There are some People in whom the Membrane which lines the Passage, and

the *Membrana Tympani* are so fine, that we cannot inject their Ear with these sharp and spirituous Liquors; and then we must content our selves with dropping some upon some hot Bread, which may be held upon the Ear. It is also a good Method to hold these Liquors in the Mouth, because their spirituous Particles become elevated, and pass thro' the Aqueduct into the Ear; and therefore for the same reason Masticatories are us'd with Success.

It is very easy to explain the Action of these Medicines, since all of them being of a subtile and penetrating Nature, they open the Ducts of the Glands, and make room for the Evacuation of the superfluous ferous Humours. To this I shall add an Observation, which was communicated to me by Mr. *Passerat*, a very skilful Physician and Surgeon, of a young Nobleman about eleven or twelve Years old, to whom it frequently happen'd in the beginning of the Spring and Autumn, that the Glands of the Passage were swell'd in such a manner that the Parts touch'd one another, and that it was impossible to introduce any thing into it. At first they us'd to drop some Oil of sweet Almonds into the Ear, to

assuage the Pain, afterwards they made use of a Decoction of Barley and Agri-mony, which is deterfive and desiccative; and by this means, the Ear after having discharg'd a Moisture which was almost like Pus, recover'd its pristine State.

*The Diseases
which the
Membrana
Tympani is
liable to, are,
Relaxation.*

I come now to the Diseases of the *Membrana Tympani*, which are Relaxation, too great Tension, Schirroufness and Rupture. The Relaxation proceeds from too great an Humidity, which moistens the Membrane; this Symptom commonly accompanies that Obstruction of the Passage, which is produc'd by the swelling of the Glands, which we have already describ'd, and contributes in a great measure to the Thickness of Hearing, in those People who are subject to Fluxions from Catarrhs; and therefore, as Experience demonstrates daily, South Winds, Fogs and Rainy Weather diminish the Sense of Hearing.

Too great Tension.

The extraordinary Tension of the *Membrana Tympani*, produces a quite contrary Effect; so that it makes the least Noises become insupportable: this Tension happens in violent Pains in the Head, and in acute Fevers, because the Tensions and Irritations of the Mem-brane

branes of the Brain are communicated to all the neighbouring Membranes.

The Schirroufness of the *Membrana Schirroufness*.
Tympani proceeds from too great a Dryness, as it is visible in old People; and besides this, we know by an infinite Number of Observations, that the Membranes of the Body may become callous, and even bony: And this is what I have particularly observ'd in the *Dura Mater*, and in the Coats of many Arteries, which I have often found ossified; which may make us imagine that the *Membrana Tympani* may sometimes grow hard and cartilaginous, and so occasion an incurable Deafness.

Lastly, The *Membrana Tympani* is *Rupture*.
liable to be ruptur'd either by some external Cause, as by an Ear-Picker, which we may push too far in without thinking of it, or by some Strain in shutting the Nostrils and Mouth, and forcing back the retain'd Breath with Violence; which Case happen'd to a Person of my Acquaintance. This Action of the Air is remarkable in Sneezing, in which we perceive that the Air which passes suddenly up the Passage, forces the *Membrana Tympani* outwards, and so causes a painful Tension. This may also

Or at least
Disunion
from the Bone
to which it
was before
united.

happen in Quincys and in Difficulties of Respiration, where the *Fundus* of the Mouth and of the Nose are swell'd by any Cold or Inflammation: for the Air which is driven out of the Breast not having the Liberty of passing out, forces it self into the Passage which leads from the Palate to the Ear with such Violence, that it is capable of lacerating the *Membrana Tympani*. *Tulpius* gives us two considerable Examples of this in his 35th Observation of his first Book. It is somewhat difficult to explain how the *Membrana Tympani*, which is so strongly inserted into a Groove, does not resist the Impulses of the Air; nevertheless, if we consider that this Groove is not continued in the whole Circle, but that it ends near the Place which answers to the Entrance of the Passage, which penetrates into the *Cavernulæ* of the *Processus Mammillaris*, as may be seen in *Plate VII. Fig. II.* and that at this Place the *Membrana Tympani* is only join'd to the Edge of the bony Passage of the Ear; it will readily be conceiv'd, that it may easily be forc'd out and disjoin'd at this Place; and by this afford a Passage for the external Air to enter in. We may perceive by this how greatly *Tulpius* is deceiv'd, when he
imagines

imagines that the Passage which passes from the Ear to the Palate contributes not only to the renewing of the Air of the *Tympanum*, but also affords a Passage to the Air we breathe upon certain Occasions; which Notion he has pretended to establish upon the Observation of those two Asthmatick Persons, we spoke of before, and upon the Opinion of *Alcmaeon*, who, from the Account of *Aristotle*, imagin'd that there were some Goats, who breathe through their Ears. Moreover, the *Membrana Tympani* may be eroded by the Acrimony of the Pus which is retain'd in the *Tympanum*, or in the Inside of the auditory Passage; we find many Examples of this in *Fabricius Hildanus*, *Schenkius*, and in many others. In what manner soever the *Membrana Tympani* be broke, it happens that in shutting the Mouth and the Nostrils, the Air comes out of that Ear with Noise, and with such a Force that it can extinguish a Candle. As for the Hearing, it is preserv'd for some time, but it insensibly grows weaker, and is entirely lost at last; which demonstrates, when it is broke, that this *Membrana Tympani* is not absolutely necessary to hear with, and that its principal Use is to transmit the

These Causes do not occasion an entire Privation of the Hearing at first: But only some time afterwards.

Vibrations to the Air contain'd in the *Tympanum*, and to the small Bones, and to keep off the Injuries of the external Air. The external Air may alone suffice to agitate the little Bones, and the immediate Organ, and excite the Sense of Hearing; but as it destroys all the Parts of the internal Ear by its Coldness, and its other excessive Qualities, it takes away at last the Sense of Hearing.

Cure of the Relaxation.

In the Relaxation of the *Membrana Tympani*, we must use the same Remedies which are us'd in the Obstruction proceeding from a Catarrh. In the Tension

Of the Tension.

besides the Remedies proper for the Distempers from which it is produc'd, we must foment the Ear with Milk, Oil of sweet Almonds, or with some emollient

The Schirroufness and Rupture are incurable.

Decoction: The Schirroufness and Rupture of this Membrane are incurable.

The Diseases of the Tympanum, and of the Labyrinth, are

As for the *Tympanum* and the *Labyrinthus*, as they are bony Parts cover'd only with a Membrane, I don't conceive how they can be liable to any other Diseases than to a Caries of the Bone, and to Inflammation of the Membranes. The

Caries of the Bones.

Caries of the Bone happens sometimes after those Abscesses of the auditory Passage which break in the back part of the Ear, and then it hath been remark'd that a

Fistula

Fistula hath been form'd above the *Processus Mammillaris*, which hath penetrated into its *Cavernulæ*, and has cast off in Scales, the little *Laminæ* which compose them. This *Caries* is accompanied with a very offensive Smell, and with very bad Symptoms, and it easily penetrates into the *Tympanum*, by the means of the Passage which has already been spoken of in the first Part, which destroying all the therein contain'd Parts, cause Deaf-^{Which may}ness: But this very seldom happens; I ^{cause Deaf-}have had but one or two Examples of it. As for the Inflammation of the Mem-^{Inflammation}branes, I have often found in dissecting ^{of the Mem-}the Ear, the *Tympanum*, *Vestibulum*, the ^{branes,} Semi-circular Canals, and the *Cochlea* fill'd with thick Matter, which might proceed from some Abscess of the Mem-^{And Abscess}branes which line these Parts. I don't ^{of the Mem-}doubt but that this may be the Cause of ^{branes.}Deafnesses, as well as the Collection of other Humours, which may be form'd in all these Cavities: and what renders this Opinion more probable, is the Difficulty there is in the discharging this Matter out of the *Tympanum*, because its Cavity is situated lower than the Orifice of the Passage which goes from the Ear to the Palate; and therefore these

Liquids can't fall into the Mouth without we bend down the Head in a particular manner: And before they can be discharg'd through the auditory Passage, they must first lacerate the *Membrana Tympani*, which they cannot do except they are very acrimonious. We may also suspect that the *Lamina Sjralis* may be eroded by the Acrimony of the Matter, and that it may even become too lax or too callous, much in the same manner as the *Membrana Tympani*, which I don't positively assert, never having had an Example of it.

*Inflammation
of the Lamina
Spiralis.*

*Which may
grow carious.*

*Cure of the
Caries.*

I can't recommend better Remedies in treating of the *Caries* of the Bone which happens in the Ear, than those which have been described by Monsieur *Deymier*, a very skilful Surgeon, from whom I had this Remark: At first he dilated the Entrance with a prepar'd Sponge, which made a pretty considerable Opening, so that he cou'd apply his Medicines upon the carious Bones; after that, he made use of Lint dipt in the imperial Water, in which he had dissolv'd a little Camphire; but as this incarn'd the Sides of the Ulcer too soon, and the *Caries* remain'd still, he had recourse to *Euphorbium*

phorbium in Powder, which he made use of with good success; this produc'd some little smarting but light Pains, which did not last long. The Use of this Powder produc'd the desir'd Effect, that is to say, the Exfoliation of the Bone, in hindering the *Fungus* from sprouting up. He made use also of *Euphorbium* in a Tincture with Spirits of Wine, to which he added some Myrrh and Aloes. The *Caries* being thus consum'd, and the Bone exfoliated, he return'd to the Use of the imperial Water, till he made a perfect and entire Cure of it; and over the Lint he apply'd the Plaister of *Janua*, to which he added the Essence of Juniper and of Cloves, and a little Oil of Marigolds.

In the Inflammation of the *Tympanum*, *Cure of the* and of the *Labyrinth*, topical Remedies *Inflammation* are almost of no effect; in this Case we *of the Mem-* must keep to the internal and general Remedies, *branes.* which also have no better Success, because the Abscesses break out in the Inside of the *Tympanum*, and of the Cavities of the *Labyrinth*, from whence the Matter can't possibly be discharg'd: so that these Humours being collected together in these Cavities, occasion an incurable Deafness.

The

*The Diseases
of the auditory
Nerve.*

Obstruction,

And Pressure,

*Which may
proceed from
Tumours hap-
pening upon
the Brain.*

The Diseases of the auditory Nerve are Obstructions and Pressure, when the whole Brain is overflow'd by serous Humours in an Apoplexy, and in any Palsy, it is evident that the Nerve will be obstructed in the same manner as the others are. Besides this, we may easily conceive that the Obstruction of the Nerve alone, without any other Fault in the Organ of Hearing, may occasion a Deafness, in the same manner as the Obstruction of the optic Nerve produces a *Gutta Serena*. A Pressure upon the Nerve produces the same Effect; it proceeds from many Causes, as from the Blood and from other extravasated Fluids, as we find in the greatest Number of Apoplexies, or from any Tumour. I find an Example of this last Case in Monsieur *Bonnet*, a celebrated Physician of *Geneva*, in his first Book of practical Anatomy, the 53d Observation of the second Section; which relates, that Mr. *Drelincourt* found in the Brain of a Man that had dy'd of an Apoplexy, a *Steatoma* between the *Cerebrum* and *Cerebellum*, which at first caus'd a Blindness, afterwards a Deafness, and lastly, an entire Privation of all the animal Faculties.

It

It is easy to know this Obstruction, *It is difficult to know whether the* or this Pressure upon the Nerve, in the Eye where all the Parts are transparent *Deafness proceeds from any Fault in the Nerve, or from any Defect in the Organ.* and diaphanous; for when there is no Fault to be perceiv'd in these Parts, we have reason to suspect some Obstruction of the optic Nerve; but in the Ear all the internal Parts are hid from our Sight, so that we can scarcely judge whether the Fault is in the Organ, or in the Nerve. Nevertheless, if any Stupor or Palsy has preceded this Deafness, or else if there is any other Sense taken away at the same time, we may reasonably suspect that the Brain is affected, and the Nerve also, by Obstruction or by Pressure. In this Case, we must prescribe the same Remedies which are us'd in Palsies, frequent Purges, Emetics, cephalic Waters and Spirits, Sudorifics, Baths, Masticatories, and Sternutatories, &c. The Pressure which is caus'd by some Tumour is incurable.

The Diseases which have been explain'd hitherto, take away quite or diminish the Sense of Hearing; but the Noise in the Ear is a Depravation of it; *The Noise in the Ear is a Symptom, the Causes of which are difficult to explain.* this Depravation consists in rendering the Ear sensible of Noises which are not in reality, or which are not external; so that
it

it being already attentive to one Sound, it is less capable of receiving the Impressions of external Sounds, except they are extremely violent.

The Ancients attributed it to the implanted Air.

The Ancients imagin'd that the true Reason of the Symptom consisted in the Motion and Agitation of the implanted Air in the Ear. They related that this Agitation was commonly caus'd by Winds and Vapours which came into the Ear from all the whole Body, as it happens in some Fevers, or from some Part of it, as from the Stomach or the Brain; or that it proceeded from some pituitous Fluid inclos'd in the Cavities of the Ear; they wou'd also have explain'd all the different Sorts of Noises in the Ear by the Quality, the Consistence, and the Motion of the Fluids, or Air, which are collected in the Inside of the Organs of Hearing. I shall not stop here to take notice of all that may be defective in this Explanation, one may judge pretty well of it by the Idea that I shall give of this Noise in the Ear; I shall content my self with saying, that there is no Appearance that these different Sounds, which they imagine we hear, are caus'd by any thing which in reality strikes upon the Ear, to produce the Sounds of Bells, murmurings of Waters, and

and an infinite Number of other Sounds, which Persons subject to these Noises in the Ear are every day sensible of, and that it is credible, that the most part of these Buzzings in the Ear are but false Sounds, and that these Appearances of Noise may be produc'd without any Wind being in the Ear, or without Matter which strikes the Membranes externally, which compose the immediate Organ of Hearing, as I am going to explain it.

It is my opinion, that the Noise in the Ear, consists in the Perception of a Sound which is not in reality, or of an internal Sound. To explain how we can be sensible of a Sound which is not in reality, we must take notice that the Action of Hearing consisting in a Vibration of the immediate Organ, it is sufficient that this Vibration be excited to cause a Sound, without it's being necessary that this Motion be produc'd by the Air; for in the same manner that we conceive, how Vision, which depends on the manner in which the *Retina* is agitated by the visual Rays, may be perform'd without these Rays, when this Agitation is produc'd from any other Cause, as it happens when the Eyes see Sparks of Light in the dark, after hav-

It is more reasonable to believe that it is commonly produc'd by the Vibration of the immediate Organ.

ing

Which is proving receiv'd a Blow: we may also say, that when any other Cause than the agitated Air produces in the Organ of Hearing, I mean the Inside of the Substance of the Membranes, this Agitation, which is regulated in the same manner, that it commonly is by the Air which brings the Sound; the Ear seems to be struck by a Sound which in reality is no more than the Light of the before-mention'd Sparks is a true Light. But what renders this Comparison pretty just, is, that as these false Appearances of Light, which are not caus'd by external Objects, have nothing in them distinct and particular, but only a simple Light; the Sight of a more complex Object, requiring the Concurrence of too many Things: So it scarce ever happens, that the Noises in the Ear which we are treating of, have any Sound but what is confus'd; the Whistling and Tinklings which are the most distinct Noises in this Symptom, being but meer Sounds.

Which may be attributed to the Diseases which produce this Symptom.

For to determine what can be the Cause of this Agitation in the immediate Organ, we must examine the Distempers in which these Noises are found; these Distempers are Inflammations and Abscesses in the *Tympanum* and *Labyrinth*,

rinth, and the Diseases of the auditory Passage. Inflammation and Abscesses in the *Tympanum*, and in the *Labyrinth*, necessarily cause Vibrations in the *Lamina Spiralis*, and in the Semi-circular Canals, either by the Tension of the Membranes, or by the Vapours which perspire, and are mix'd with the Air in the *Tympanum*. Sharp Humours, Worms, extraneous Bodies, the Contraction of the Passage which succeeds the Swelling of the Glands, and in general every thing that causes Pain, and the other Symptoms in the auditory Passage, which I have before described, agitate the Membrane of the Passage, and the *Membrana Tympani*, which is sufficient to communicate this Agitation to the immediate Organ.

The second sort of Noise in the Ear *Sometimes the* is that in which we perceive a true, but *Noise in the* an internal Sound. It is thus, we per- *Ear proceeds* ceive a Buzzing when we stop our Ears; *from an external Impulse;* this Noise is caus'd by the Friction of the *As when we* Hand, or by the Pressure which rumples *stop our Ears* the Skin and the Cartilages, whose Par- *with our* ticles may occasion Agitations in this *Hands.* Place; the Elasticity of the inclos'd Air, and the Vapours which incessantly proceed from Bodies, may also contribute to them,

them, when those Vapours which proceed from the Hand, join'd with those which come from the Membrane of the Passage, being confin'd, strike upon the *Parietes* of the Cavity, and produce Vibrations; which though they are very small, yet they form a true Sound, which becomes sensible from the Proximity and Continuity of the Parts, and also by the help of the Reflections which are form'd in this inclos'd Cavity.

The Diseases which cause this sort of Noise in the Ears, are, The Commotions of the Cranium.

The Commotions of the *Cranium*, and the Distempers which contract the Passage, may cause such sort of Noises in the Ear, if we suppose that the Shocks the whole *Cranium* receives, are communicated to the immediate Organ only by the Continuity of the *Os Temporale*; I mean, at the very Time of the Commotion: for as for those which afterwards succeed, they must be attributed to the Disorder of the Spirits, as we shall see in the Sequel. In the same manner, the swelling of the Membrane of the Passage may, in contracting it self, produce a like Effect. Besides this, it often happens that we perceive a Pulsation in the Inside of the Ear, which makes us believe that we hear something beat, and this Pulsation is sometimes so strong, that other People

The beating which we imagine we hear in the Inside of the Ear is caus'd by The Contraction of the auditory Passage.

People may hear it. I have made an Observation upon this, of a Lady of *Picardy*, who upon the least violent Exercise perceiv'd so troublesome a Pulsation, that it seem'd to her that she had a *Pendulum* fix'd to her Head, and this Pulsation was also heard by those who came near her. Now this beating is nothing else but that of a dilated Artery, because it always perfectly agrees with the beating of the Heart; and this Perception of an internal Sound, appears to me absolutely like that Symptom which is observ'd in imperfect Suffusions. Those Persons who are seiz'd with this Disorder, see Motes and Flies flying before the Objects; these Motes and Flies are nothing else but the viscus and gross Particles which begin to be amass'd in the aqueous Humour, which by their Motion agitate the *Retina*, and necessarily produce a Sensation. But, say they, if these are true Noises, and if the Organ distinguishes them such as they are, why are they put in the Number of tinkling Noises in the Ear? I answer, that in reality these Noises are perceiv'd such as they are, but that the Hearing is deprav'd in mistaking these Noises as coming from some external Object, in the same manner that those who have a Cataract beginning to be form'd, imagine these

these Appearances of Motes and Flies to be external Objects, and put out their Hands to catch him.

The immediate Vibration of the Extremities of the nervous Fibres, to their Origin in the Brain, may cause all the Appearances of Noises.

Besides this, I imagine there may be a Perception of a false Noise without any Defect in the Organs of Hearing: Which happens every time that the Parts of the Brain, where the Filaments of the auditory Nerve terminate, are mov'd and agitated in the same manner that they us'd to be vibrated by Objects. What induces me to believe this, is, that I take notice of a great Number of Diseases of the Brain which are accompanied with a Noise in the Ear: As for example, Deliriousness, Phrenzy, Vertigoes, and those Persons which fall into Epilepsies and Swoonings, perceive these buzzing Noises in their Ears, which are as the Præcursors of Paroxysms. As there is an irregular and extraordinary Motion of the Spirits in all these Distempers, it is much easier to imagine that the agitated Spirits may strike upon the Extremities of the auditory Nerve, and so by this means cause a Sensation of Noise, than to imagine that there is a Defect in the Organs of Hearing. This manner of explaining the Noise in the Ear, appears to me reasonable enough; and methinks we may add,
that

that as the Motion of the Spirits is very irregular and disorder'd in all these Distempers, so the Sounds and Noises in the Ear must in this Case be very confus'd and very different from the Sounds which we commonly hear. I shall without doubt be told, that this is a false Imagination, and not a Symptom of the Ear. I agree to it, and this is what I alledge: *Which are not so much a Symptom of the Diseases of the Ear.* As it is thought that we can never hear without the Ear is struck upon, we attribute all Noises to this Organ; nevertheless it is indifferent whether the Fibres of the Nerves be shaken next the Ear, or next the Brain, there will still arise the same Sensation from it: and this is caus'd in the same manner as in the Vertigo, in which we know that the circular Motion of Spirits alone produces the same Effect as if the visible Objects had really this rotatory Motion; or in frantick Persons, who fancy they see Motes which are not in reality, which is caus'd only by the Agitation of the Fibres of the optic Nerve in the Inside of the Brain. As they also attribute the Symptoms of Suffusions and Phrenzy to a deprav'd Imagination, we must attribute the Noises in the Ear, which succeed the Distempers of the Ear, to the same Cause, although they very often don't

don't in any manner depend on the Indispositions of the Organ of Hearing.

As of those of the Brain, which produce a second sort of Noise in the Ear.

We may after this manner lay down two Sorts of Noises in the Ear, one of which proceeds from the Disorders of the Brain, the other from the Disorders of the Ear; those which succeed the Disorders of the Ear are, as aforesaid, either true or false; and of these some are call'd Tinklings in the Ear, others Whistlings, others Buzzings, others Murmuring, &c. And in general we may say, that the hollow and buzzing Noises are produc'd by a slow Vibration, and the Whistlings and Tinklings by a close and strict Vibration, which is confirm'd by the remote Causes of these Symptoms: Colds, for example, and Suppurations, in which the Membranes are relax'd, commonly produce a Buzzing; and Inflammations and Pains in the Ear, in which these Parts are commonly tense and dry, Whistlings and Tinklings. We must also believe, that all these Noises make the same Impression upon the *Lamina Spiralis*, and upon the Semi-circular Canals, as grave and acute Sounds.

The Cure of the Noise in the Ear generally depends upon the Diseases of the Brain,

Brain, or of the Ear which produce it. *The Cure of the Noises in the Ear, is the same as that which is us'd for the Diseases from which they are produc'd.*
To this I add, that in the Whistlings and Tinklings we must make use of very nigh the same Remedies, as those which have been describ'd in speaking of the Pain proceeding from Heat, and of the Tension of the *Membrana Tympani*; and that in the Buzzings we may make use of those which have been prescrib'd for the Pain which is occasion'd by Cold, and for an Obstruction proceeding from a Catarrh. After which, it will be no difficult matter to chuse the most convenient, if we consider the Circumstances which may afford us the necessary Indications for the Cure.

FINIS.

H





A

GENERAL TABLE

O F

The Organ of Hearing.

PART the First, containing the Structure of the Organ of Hearing.

THE external Part of the Organ of Hearing call'd only the Ear, Page 1. is compos'd of a Cartilage, 2. of Skin, of Fat, of a nervous Membrane, of two Muscles, id. of Arteries, 4. of Veins, 5. and of Nerves, 6. The Hole of the Ear is divided into two Parts, 1st. The cartilaginous Part, which is broke off in many Places, id. and cover'd with a Skin, adorn'd with many little Glands, 8. and is connected to the Os Temporum by a Ligament, id. 2dly, the bony Part, 10.

H 2

The

A General TABLE.

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